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Power Plant ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

FEBRUARY • 1946

Features

TOPPING AT HELL GATE • FLOATING POWER • THE BUCKET ELEVATOR • MOTORS FOR AUXILIARIES • THE DEVELOPMENT OF ATOMIC ENERGY • CONTINUOUS BLOWOFF • COMPRESSION DISTILLATION • EFFICIENCY BUREAU • CONTENTS PAGE 5

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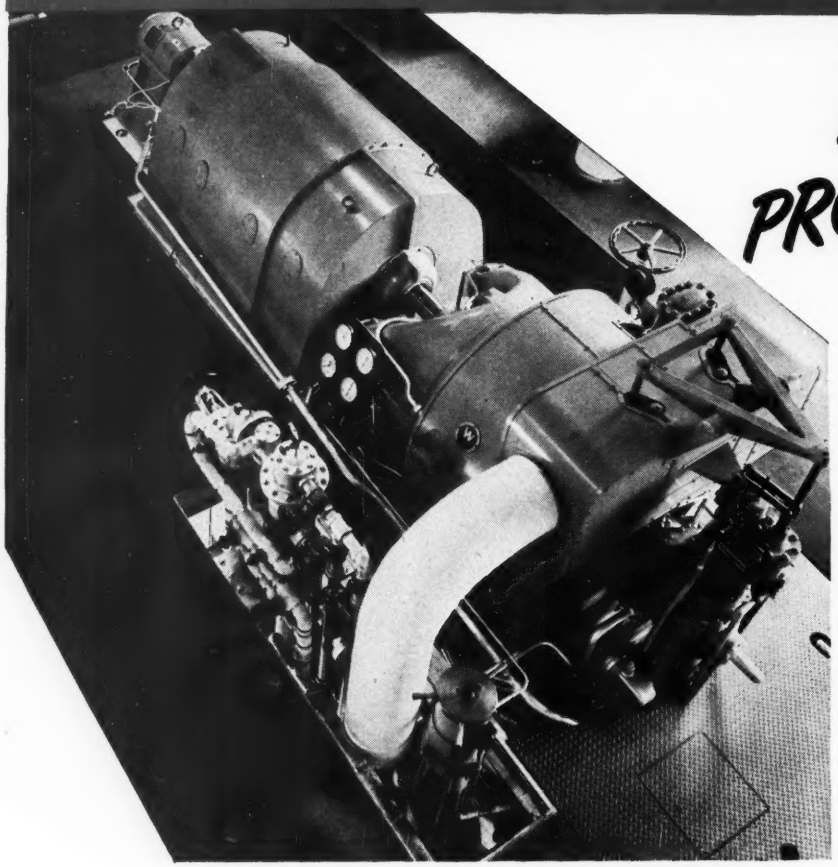

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Power Plant ENGINEERING

February 1946

VOLUME 50—NUMBER 2

Cover: From this power distribution control board in the power house of the Rouge plant of the Ford Motor Co., operators control the turbine generators and the distribution of power from the power plant to sub-stations at the Rouge and outside plants. The plant has a capacity of 345,000 kw.

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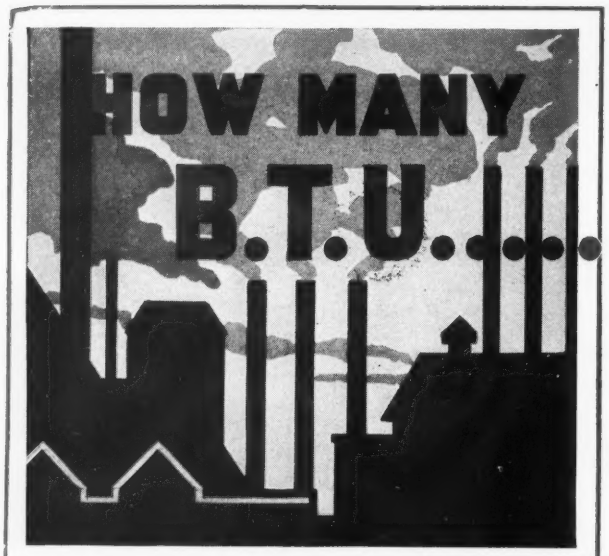


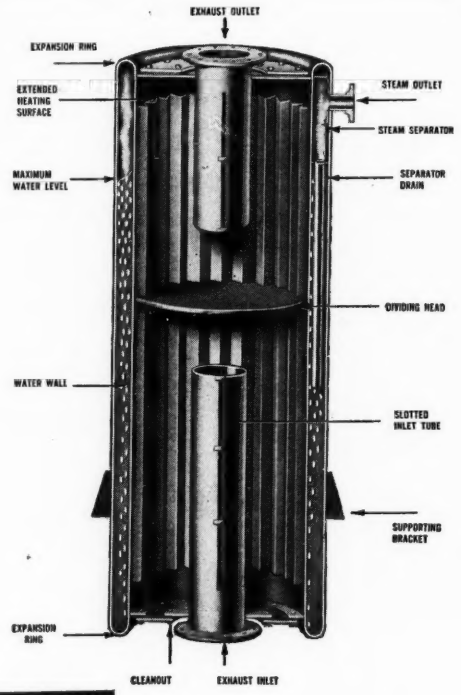
go up the flue?

YOU CAN SAVE THIS HEAT WITH MAXIM HEAT RECOVERY SILENCERS . . .

In any operation where Diesel power is used, an important amount of usable heat goes out the exhaust pipe and is totally wasted. This heat, transformed into steam or hot water, could in most cases be used to good advantage . . . without a cent of added fuel cost.

Maxim Heat Recovery Silencers make this possible. They are efficient silencers and, where necessary, spark arrestors. But, in addition, they provide for the recovery of waste exhaust heat to produce steam or hot water for heating or processing operations. Automatic controls are available to control steaming rate, and these silencers may, due to their special construction, be run dry without harm to the unit.

Maxim Silencers without the heat recovery feature are available for effective silencing of internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge. Engine exhaust silencers available with or without spark arrestor.



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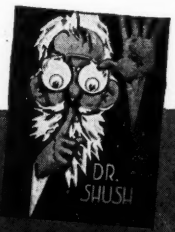


ARMY ★★ E ★★ NAVY

MAXIM

Front Lines—

THE POSITION of the technologist under the Wagner Act should be—but unfortunately is not—one of vital concern to all engineers today. How many of us know what that position is? An attempt to explain it, with both its advantages and disadvantages, has been made in a new book, The Technologists' Stake in the Wagner Act, by M. E. McIver, H. A. Wagner and M. P. McGirr, published by the American Association of Engineers. The book is dedicated "to an unrealized aim and an urgent need—Unity in the Engineering Profession." A more detailed discussion of it will be given elsewhere in *Power Plant Engineering*.

REMOVAL OF 13,000,000 KW of Germany's electric generating capacity, about 60 per cent of the total installed, leaving about 9,000,000 kw, is one of five important steps to be advocated to the Allied Control Council as part of the program for German disarmament. A report prepared by a committee of the OWU last spring emphasizes that strict control of German power would be very effective if combined with other controls over industry, but not very effective if those other controls are not enforced. For example, it is impossible, first of all, to determine how much power capacity should be left the Germans until a precise determination can be made of how much industry will be left. Among other things, no synthetic oil or synthetic rubber manufacturing capacity are to be left, under other provisions of the overall control program. Thus the entire control program must be coordinated and, in addition, must be fitted into the Russian, British and French programs designed to attain the same objective. That objective is real control over Germany's war-making potential, which, according to most competent observers was much greater in 1944 than it had been in 1939.

TWO NEW MAN-MADE ELEMENTS, as yet known only by their atomic numbers, 95 and 96, have recently been identified, as reported by Dr. Glenn T. Seaborg to the Chicago Section of the ACS. They were produced by bombardment of uranium and plutonium in a cyclotron, reports the Industrial Bulletin of Arthur D. Little, Inc., commenting that this announcement indicates the mysterious Manhattan District is sponsoring research not related to immediate war needs. Only submicroscopic quantities of them are as yet available but these are adequate for investigation of chemical properties. Apparently the new elements are radio-active, but whether they disintegrate with release of energy, like plutonium, has not been disclosed. Availability of these two new elements will permit research leading to further knowledge of how the group of "heavy elements," on which nuclear scientists are focusing attention, fits into the periodic classification that has led to so much understanding of all groups.

MORE EFFECTIVE use of aircraft power plant exhaust gases, such as for anti-icing operations, was discussed before the 1946 annual meeting of the SAE. John J. Draney, of Consolidated Vultee Aircraft Corp., proposed that exhaust heat be forced by jet pump through ducts within the structure to leading edge surfaces likely to become iced, and said that even the propeller hub similarly could be given ice protection. Improved materials must be available, however, before substantial progress can be made in utilizing exhaust gases, it was explained by Ralph L. Haver and Harry A. Goodin, Jr., of Ryan Aeronautical Co., San Diego. Stainless steel and iconel were said to be inadequate. A new material, 19-9DL, offers some promise, but they asserted its limitations are exceeded even before it has had a chance to prove itself. Such materials, they said, must withstand temperatures of 3000 F. and above, which means they must have heat resistance better than double that of any material now available.

WHITE COLLAR FARMERS—living in the country, working in the city—a wonderful way to live, many people have thought for many years. Nothing new about the idea at all. But there are ways and ways to go about it. These are interestingly discussed in the December, 1945, issue of Ethyl News.

CITIZENS FIRST; VETERANS SECOND seems to express the general thesis of Charles G. Bolte's new book better than the title it now bears—The New Veteran (Reynal & Hitchcock, New York). That's the opinion of Sergeant Bill Mauldin, creator of the immortal Willie and Joe cartoon characters of World War II, in a very interesting review of this new book on veteran attitudes and problems by one who is himself a real combat veteran. We chuckled over the last paragraph of Mauldin's review: "I was very careful about Bolte and his ideas and his organization for a long time. I looked the guy over pretty carefully and with a great deal of skepticism. I am convinced that his book is a darned good thing and so is his outfit, but I took my time before saying it. You see, he was a second lieutenant."

AUTOMOBILE RACING by cars with 12.5 in. wheel base and 7.5 in. tread, powered by gasoline engines of 10 cc piston displacement and capable of speeds of 70 to 80 miles per hour on a rail track, has grown into considerable of a hobby among a group of enthusiasts in Chicago. Many of them are people adept at precision machine work, for the building of these cars to very close tolerances, with many of the parts made of cast and sheet aluminum, is no job for chicken-coop carpenters. Read all about it in the December issue of Aluminum News Letter.

WITH A DEEP SENSE of personal loss, we report the death of John A. Kershaw, Eastern Manager of Technical Publishing Co., publishers of POWER PLANT ENGINEERING, on January 16, 1946, at his home in New Rochelle, N. Y. He was 74 years old. He had been a member of our organization for 37 years.

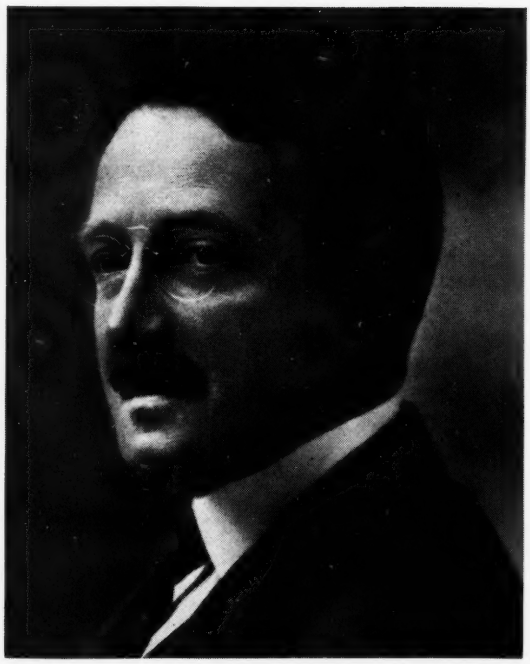
Mr. Kershaw was a native of Norwich, N. Y. He attended Norwich Academy and then entered the field of industrial publication advertising, in which he has spent his entire career. He was in charge of the copy service department of the old Hill Publishing Co. for some years. Later he served as managing editor of *Selling* (one of the predecessors of today's *Advertising & Selling)* and as a contributing editor of *Printers' Ink.* He joined Technical Publishing Co. in 1909 and has been in charge of advertising sales for our organization in the New York and New England territory ever since. Surviving are his wife, Lillian M. Kershaw, with whom he celebrated his 50th wedding anniversary on March 26, 1945, and his son, Richard B. Kershaw.

During his long career in this field, John Kershaw made many important contributions to industrial publishing and advertising. These contributions, as well as the personal esteem in which he was held by his co-workers and business associates, are best summed up in the following letter we have just received from one of his oldest friends.

Technical Publishing Co.:

Your publication has lost in the passing of John Kershaw a highly respected and capable representative; and the industrial advertising fraternity has lost a landmark, a pioneer, a staunch friend.

Forty-two years ago I joined his copy service department with The Hill Publishing Co. and have had the privilege of close contact with his activities. What he taught me about industrial advertising was important not only to me, but his advertising ideals, introduced more than forty years ago, laid a solid foundation for ultimate success in the field of industrial publication advertising. "Know how" copy was then something new, something that had not been recognized as essential, as it is today.



Later, Mr. Kershaw, as Managing Editor of the magazine *Selling,* now *Advertising and Selling,* continued to promote the idea that advertising copy should make sense and be useful to the reader.

During his long connection with POWER PLANT ENGINEERING, he built an army of business friends ready to fight in his defense at the drop of a hat should there be any occasion. That was an asset which could not be entered in the books.

A poll of the men on whom he called, and of acquaintances in the publication group, would surely indicate a high opinion of John Kershaw as a man's man, and a sterling friend with a high rating as a publisher's representative.

Like all advertising managers who knew him well, I am proud to have been rated a friend of John Kershaw.

Worcester, Mass. **A. B. FRITTS**

Why POWER PLANT ENGINEERING Has Been Late

MANY READERS have written to ask about lateness of issues. This story of printing difficulties is given not as an alibi, because we have been battling conditions beyond our control, but because you who have paid for your subscriptions are entitled to know.

POWER PLANT ENGINEERING is printed in a union printing shop in Chicago. Last September a strike of compositors in Chicago set back our printing schedule over a month and created a terrific backlog of printing jobs in this city.

Unfortunately for us and other Chicago publishers, the compositors strike affected only Chicago printing shops. Publications in other parts of the country were able to continue their regular schedules. In these days of over-loaded printing facilities, it would have been impossible to transfer our print job to some other city even if we had considered it desirable.

By almost superhuman effort, our Production Department gained back a large part of the delay caused by the September strike and the December issue was ready for the press room almost on schedule. Then a situation developed in the press-room which again slowed down our production; no over-time, no Saturday work. While we used every form of persuasion and inducement we could think of to overcome this situation, we are only customers of the printing company and have no authority in relationships between them and their unions and no right to pass judgement in any controversy.

To show how this slow-down affected our schedule, we give you one example: one December form, which normally would require two days to run, was on the press *eight* days.

On top of this we ran into two four-day week-ends over Christmas and New Years when not a press was running, next a flu epidemic put three head pressmen out of commission for another week.

This piling up of bad luck called for heroic measures. We called in a job printer we have known for twenty-five years and arranged to have the January issue printed in small forms outside our regular shop. That issue was printed in six different job shops scattered all over Chicago. It meant that paper, type and cuts had to be delivered all over town; printers unfamiliar with our kind of job had to be instructed and supervised; then the pieces had to be brought together again for binding and mailing.

But we put it over. The January issue was mailed in January. Our regular printer was able to skip January and start work on this February number directly following the completion of December.

The pressroom difficulties have been settled to every one's satisfaction and all hands have pitched in with a will to get POWER PLANT ENGINEERING back to our normal mailing schedule.

Our organization deeply appreciates the patience and understanding of you readers. We hope to get POWER PLANT ENGINEERING to you on time from now on.

WE make these surveys right along, and they result in a common-sense plan to assure correct application of the right lubricants. Briefly, this is what the Shell Lubrication Engineer will provide:

1. Survey and analysis of the lubrication requirements of your plant engines and machines.

2. Recommendations of proper lubricants, together with specific instructions as to when and how they should be used.

3. Scheduled check-ups for all critical or unusual machinery.

4. Reports (if you want reports) about the performance and economies of recommended lubricants in use in your machines. To the Shell Lubrication Engineer, though, the best report is short and sweet: "All machines continuously in service, well lubricated."

* * *

Right here we ought to warn you that the Shell Lubrication Engineer isn't going to tell you everything you're doing is wrong—he may, in fact, find very little fault with the lubricants and procedure you are now using.

Then, too, he will come to you without a rigid set of rules. Your lubricating procedures are probably based on pretty sound experiences that your own folks have had. Your problem is really one of picking out the weak spots before they become trouble spots . . .

So call the Shell Lubrication Engineer for that survey. If your property is so large that he needs help, he will have it. You are bound to gain, if it is only peace of mind!

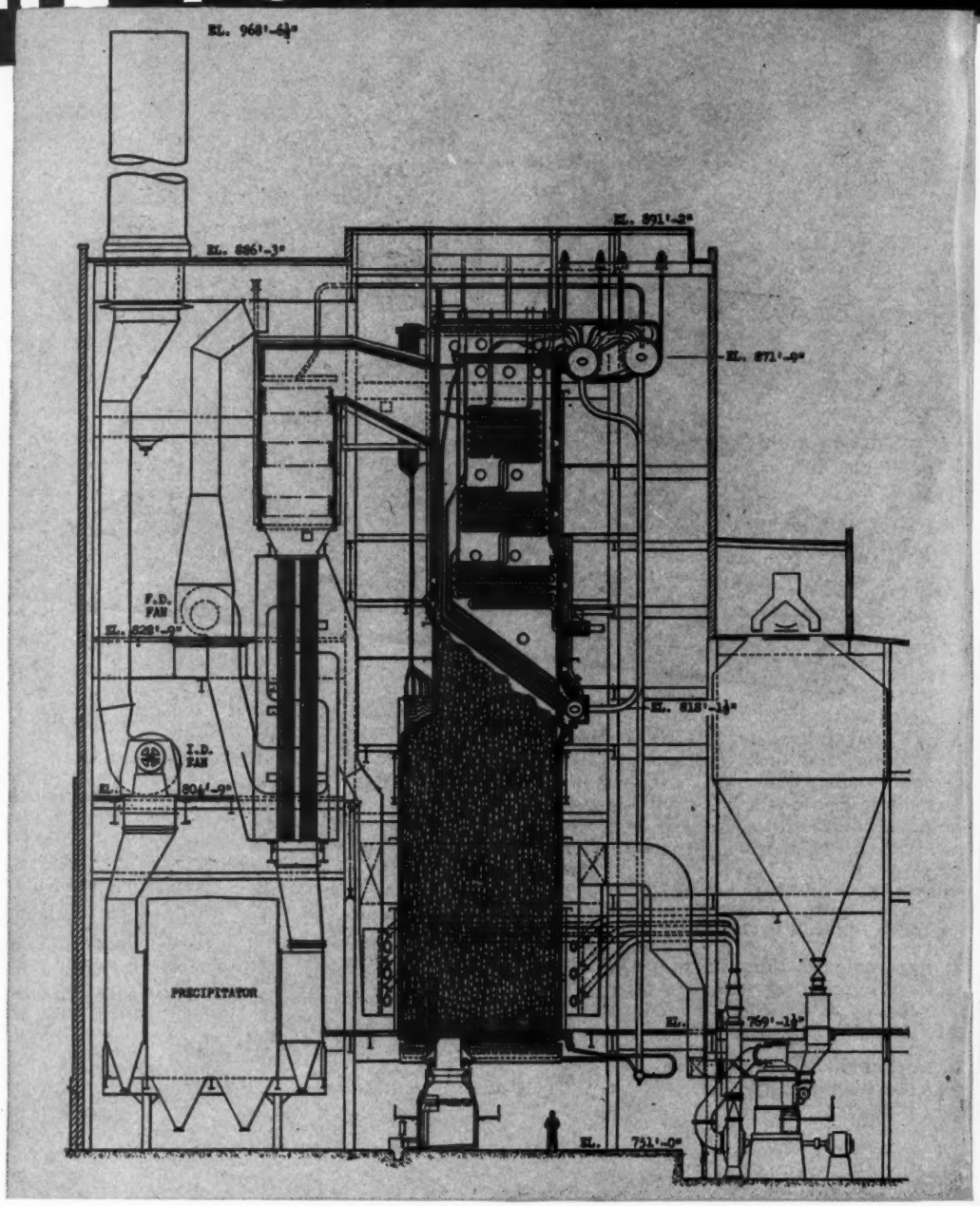
There is no obligation on your part.

Call your local Shell Representative, or write Shell Oil Company, Incorporated, 50 W. 50th Street, New York 20, N. Y., or 100 Bush Street, San Francisco 6, California.

SHELL INDUSTRIAL LUBRICANTS

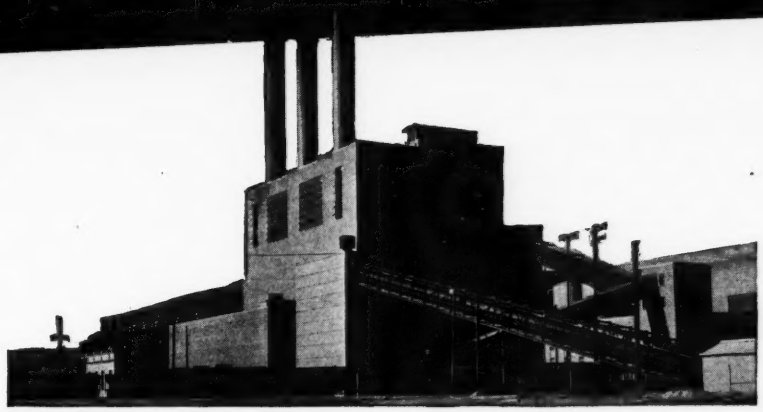
SHELL

THE POWER BEHIND



Section through one of the three large C-E high-pressure boilers in the Oak Ridge plant.

THE ATOMIC BOMB



WHATEVER the ultimate decision on divulging the know-how of atomic bomb production, it is no secret that enormous amounts of steam are required for both power and process.

C-E Steam Generating equipment predominated by a large margin in supplying the exceptional steam requirements. In the main plants engaged in atomic bomb production, a total of 33 C-E Boiler Units, having an aggregate capacity of 4,600,000 lb of steam per hr, were installed. In addition to these complete C-E Units, Combustion Engineering also furnished a number of stokers for firing boilers supplied by other manufacturers.

High Capacity C-E Units in Oak Ridge Plant

In the main power plant of the project at Oak Ridge, Tenn., three huge C-E Steam Generating Units supply steam for a number of turbine-generators. Each boiler unit has a rated capacity of 750,000 lb of steam per hr at 1325 psi and 935 F and has produced at higher outputs when required.

These C-E Boilers are of a special three-drum type, each equipped with a superheater, economizer and tubular type air preheater. The furnaces are completely water cooled and are tangentially fired with pulverized coal. A test run at an output of 724,000 lb of steam per hr showed an overall efficiency of 89.9 per cent, using coal of 11,505 Btu.

Delivery of Equipment in Record Time

At a time when speed of production was of major importance, Combustion Engineering was able to place the first of these giant steam generating units in service at Oak Ridge only 10 months after the receipt of order.

A-933

COMBUSTION ENGINEERING

C-E

200 MADISON AVENUE • NEW YORK 16, N. Y.

76 million lbs. of operating

. . . with B&W Integral-Furnace Boilers

For high availability and continuity of service, for its rapid response to fluctuations in load demands, over-all economy and suitability for all types of fuels, the Babcock & Wilcox Integral-Furnace Boiler has won sweeping acceptance in hundreds of varied installations in almost every major industry. Since its introduction in 1933, B&W Integral-Furnace Boilers have been selling at the average rate of one every three working days! The total steam capacity of existing installations now exceeds 76 million pounds per hour. This outstanding acceptance of the B&W Integral-Furnace Boiler is due to the time-tested and performance-proved soundness, efficiency and flexibility of its design that embodies these features:

1. Furnace is entirely water-cooled, using types of construction similar to the practice in large central station boilers.
2. Deep furnace, fired from one end, provides ample space for complete combustion.
3. For gas and oil firing or for medium sized coal-fired units, this unit can be bottom-supported from the operating floor level, thus occupying a minimum of head room and requiring a minimum of structural steel.
4. The self-draining superheater adds to the convenience and saves time in starting up.
5. Tubes of the third bank, which is in the zone of coolest gases, act as downcomers, insuring rapid, positive circulation at all loads.

And the B&W Integral-Furnace Boiler is designed to burn pulverized coal, oil, or gas —alone or in combination. That means plants may utilize, at highest combustion efficiency, the least expensive commercial fuel available.

From their war-time proving under unprecedented operating conditions will come still better B&W Integral-Furnace Boilers to serve industry requirements for low-cost steam.

Now Used by: TEXTILE MILLS • FOOD PROCESSING PLANTS • CHEMICAL PLANTS CENTRAL STATIONS • OIL REFINERIES • RAILROADS • INSTITUTIONS • PAPER MILLS • DISTILLERIES • GLASS WORKS • UTILITIES • CEMENT MILLS • SUGAR REFINERIES • AUTOMOTIVE PLANTS • STEEL MILLS • FOOD PLANTS • SCHOOLS

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High Availability Low-Cost Steam

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

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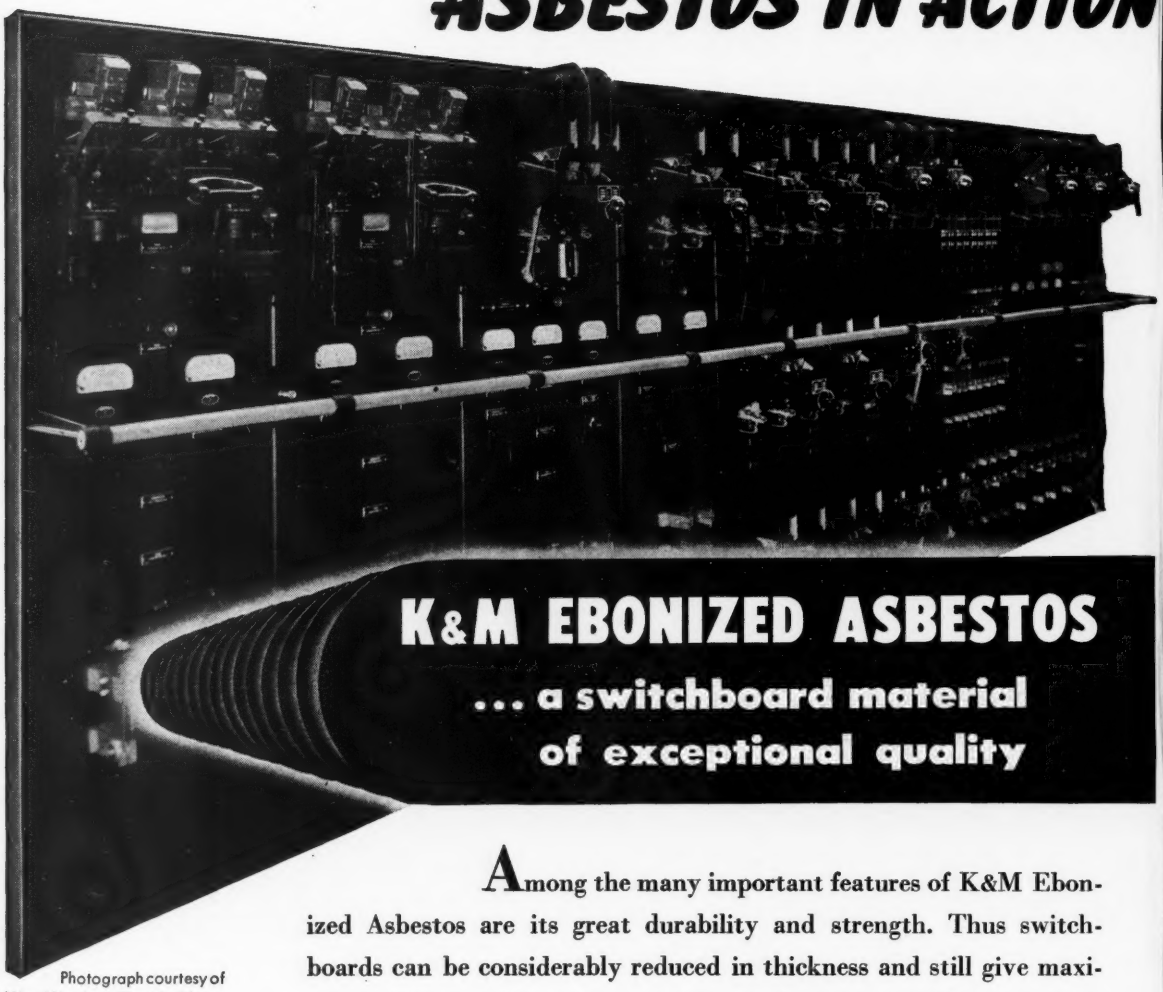
ASBESTOS IN ACTION



K&M EBONIZED ASBESTOS

... a switchboard material of exceptional quality

Photograph courtesy of Wm. Wurdack Electric Manufacturing Co., St. Louis, Mo.

Among the many important features of K&M Ebonized Asbestos are its great durability and strength. Thus switchboards can be considerably reduced in thickness and still give maximum efficiency. Other features, listed below, are equally impressive.

K&M Ebonized Asbestos is made of a combination of asbestos fibre, binding cement and insulating compound, molded under terrific pressure into strong, monolithic sheets. Comes in standard or special "panel" finish . . . from ⅛" to 4" thick.

EFFICIENT FOR BUS BAR RUNS, TESTING TABLES, CABINETS, BENCH BOARDS, COMPARTMENT LININGS AND MANY OTHER TYPES OF ELECTRICAL INSTALLATIONS

•

K&M Ebonized Asbestos is specially developed to meet the technical requirements of Underwriters Laboratories, Inc. when built into an assembled unit.

K&M EBONIZED ASBESTOS FEATURES:

- **Exceptionally high dielectric strength**
- **Uniform density throughout**
- **Withstands severe shock, vibration and wide temperature variations**
- **Resists oil and water action**
- **Does not shrink, crack or bulge**

Nature made Asbestos . . . Keasbey & Mattison has been making it serve mankind since 1873.

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

Gear Puzzle with a Payoff for your Plant!

Call in SOCONY-VACUUM for this Correct Lubrication Program

- Lubrication Study of Your Entire Plant
- Recommendations to Improve Lubrication
- Lubrication Schedules and Controls
- Skilled Engineering Counsel
- Progress Reports of Benefits Obtained

GARGOYLE Lubricants

NO, this isn't an engineer's nightmare! It's our conception of the different types of gears in your plant, linked in a continuous train. Production costs . . . and profits . . . depend on efficient operation of gears like these. Each gear has its own lubrication needs.

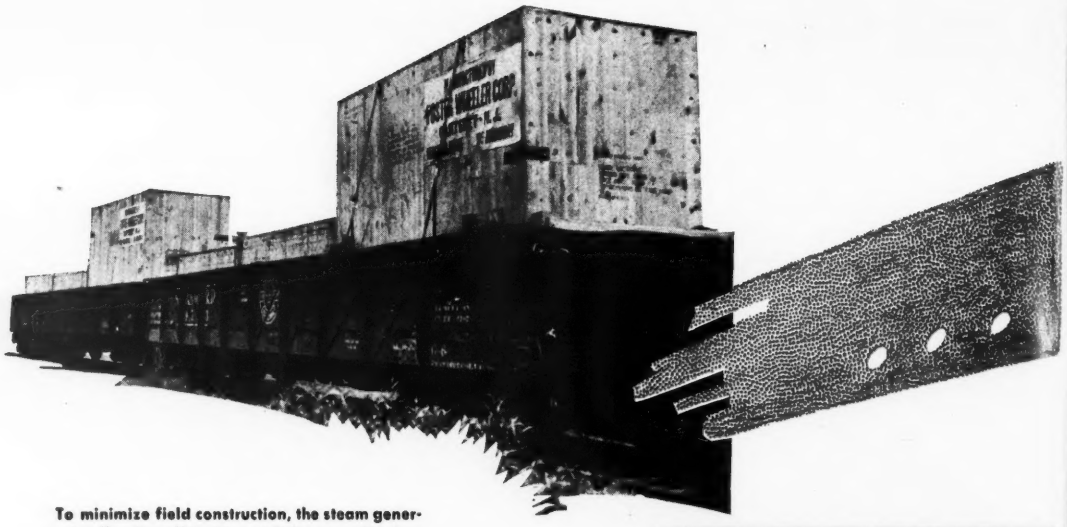
Some are ordinary open gears. Socony-Vacuum makes a special "Black Magic" fluid to prolong their life. There's a worm gear. Socony-Vacuum has special oils that stay on despite the wiping, sliding action. There are herringbone gears, hypoids, bevels and spiral-bevels. Socony-Vacuum engineers have the products . . . and the knowledge . . . to assure scientific lubrication for every type under every condition.

The same applies to all bearings and cylinders. Socony-Vacuum's great new wartime developments, backed by 80 years' lubrication experience, are available in a Complete Lubrication Program for your plant. Insure maximum machine efficiency now with this program.

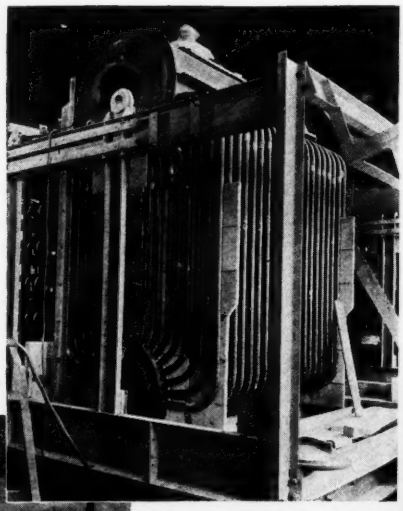
Socony-Vacuum Oil Co., Inc.

and Affiliates: Magnolia Petroleum Company, General Petroleum Corp. of Calif.

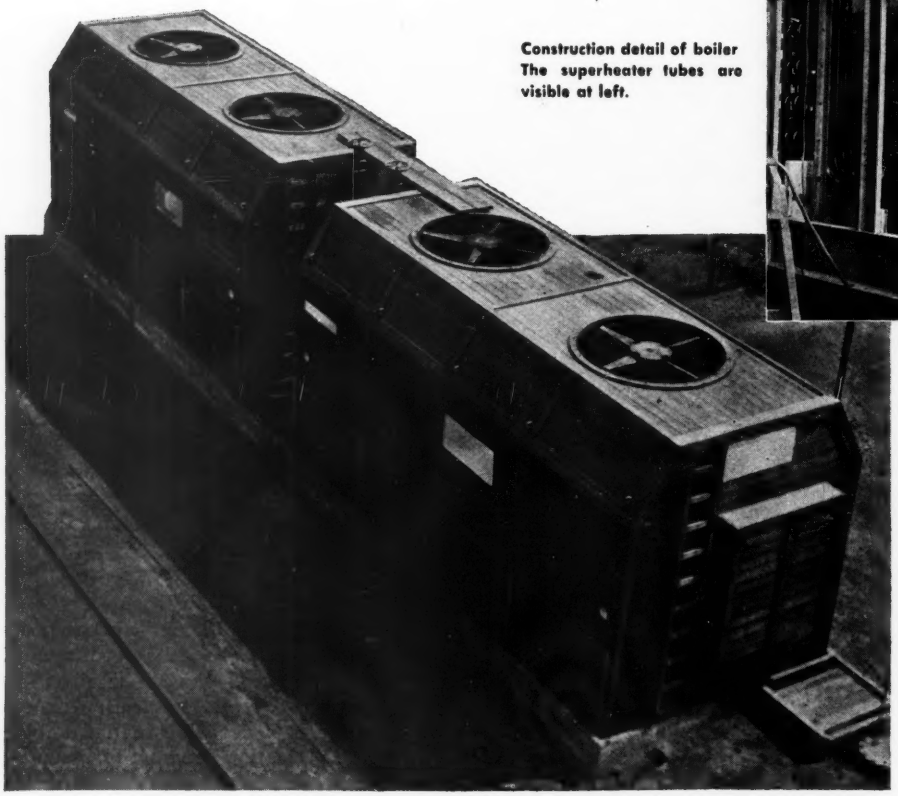
Tune In "Information Please"—Monday Evenings, 9:30 E.S.T.—NBC



To minimize field construction, the steam generating "package" is shipped fully assembled on a single railroad car



Construction detail of boiler
The superheater tubes are visible at left.



Four-cell induced draft Foster Wheeler cooling towers, component equipment for package power plants. These towers are designed to cool 950 GPM from 105° to 91°

FOSTER

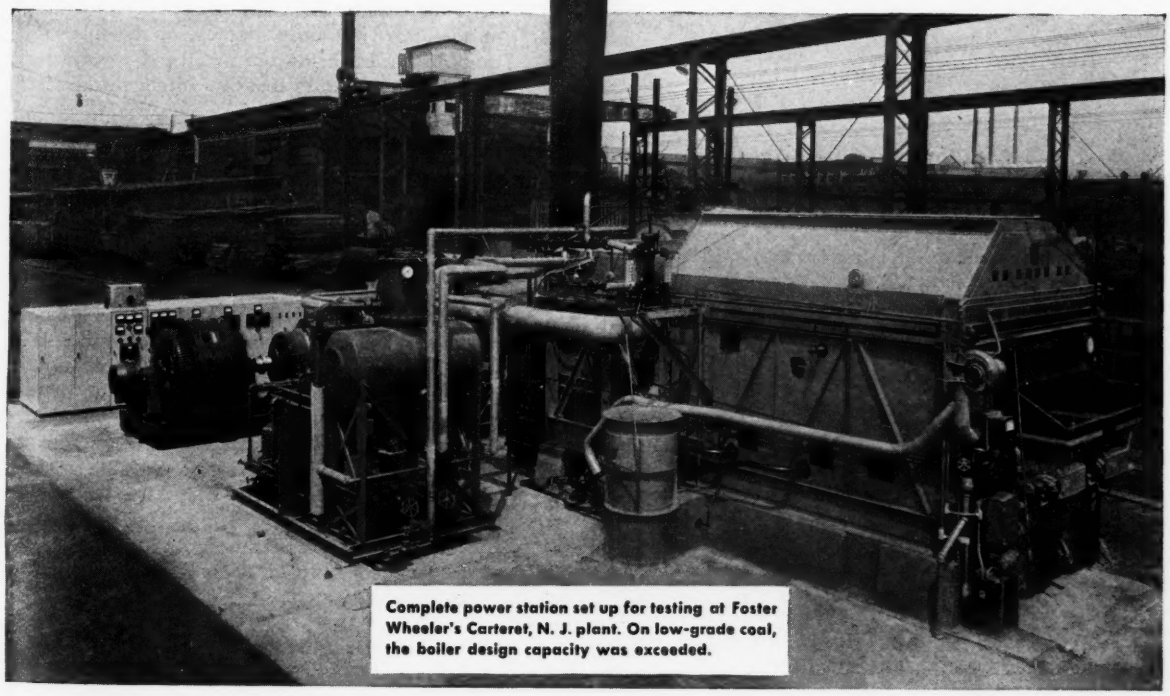
Boilers for PACKAGE POWER PLANTS

Two new concepts in steam-electric power generation—"package" and "unit" power—are today aiding rehabilitation of war-devastated areas in Europe and Asia. Hundreds of complete power stations have been supplied in types varying from field-assembled units to those shop-assembled and then shipped in a minimum number of "packages." Foster Wheeler has designed and constructed boilers for both types.

For the 1000 KW "package" type, designed by Peter F. Loftus, consulting engineer of Pittsburgh, Pa., Foster Wheeler has supplied 56 complete steam generating units. The unit includes boiler, furnace, superheater and economizer, assembled in an all-steel casing.

The boilers supply 16,000 lb. steam per hr at 405 psi and 750°F final steam temperature. Low-grade coal, or peat, is fired on a dumper-grate type spreader stoker. The furnace may also be arranged to burn logs when no other fuel is available.

FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N. Y.



Complete power station set up for testing at Foster Wheeler's Carteret, N. J. plant. On low-grade coal, the boiler design capacity was exceeded.

WHEELER FW

. . . . NOW YOU CAN HAVE *all the Soft water you want* . . . AT NO EXTRA COST!

Latest design Elgin Water Softener

The Elgin "Double-Check" Softener gives up to 44% more soft water, size for size

AUTHORITIES agree that in far too many plants there is not enough softened water for *all* the uses to which it should profitably be put. In some cases this is because requirements have outgrown water softener output; in other cases the management has not put in a softener of adequate size, either because of the space required for a larger unit or because of the greater initial and operating cost of a larger softener.

But whatever the objection it has no standing now. An Elgin "Double-Check" Softener no larger than a water softener of ordinary design will deliver up to 44% more soft water—and deliver it at far lower cost.

The reason for this higher capacity and efficiency is quite simple. The Elgin accommodates a far greater quantity of zeolite and uses it more effectively. It accommodates more zeolite because an ingenious "Double-Check" manifold system prevents the escape of zeolite and therefore permits the use of a far deeper zeolite bed. It uses the zeolite more effectively because a higher backwashing rate is made possible by preventing zeolite loss. This keeps the bed clean and active so that more "zero-soft" water is produced per pound of salt used. As is well known, a deeper zeolite bed gives far greater water softening efficiency.

Too often the use of soft water begins and ends in the boiler room. But the extra amount of soft water that costs so little more in the big-output Elgin "Double-Check" Softener permits many uses of soft water that are highly profitable through cutting labor costs, improving processes and reducing maintenance costs. Throughout the hot water system, zero-soft water eliminates scale and lime deposits in tanks, heaters and piping, cutting plumbing costs. In all plant cleaning operations it does a better, faster job with a big saving of soap and cleaning compounds. In many plant processes Elgin zero-soft water improves the quality of finished products and where jacketed equipment is involved it increases operating efficiency and cuts maintenance cost.

Ask for this New Bulletin

. . . DESCRIBING THE OPERATION AND CONSTRUCTION OF THIS REVOLUTIONARY WATER SOFTENER.*

*** Existing softeners, regardless of make, can be modernized by Elgin to incorporate the features and advantages of the Elgin "Double-Check" Softener.**

ELGIN SOFTENER CORPORATION

SOFTENERS ★ FILTERS ★ WATER TREATMENT ★ BOILER WATER CONDITIONING

No-We Didn't Put Sun Helmets and Swim Suits on our Motors-but....

"Double Trouble", moaned the experts, but the Navy stood fast. "All we want", said they, "are starting motors for diesel engines that'll stand up in tropic heat. Make them waterproof too!"

Blood pressures went up, when we ran into short-circuits. Horsepower had to be high (14-22 hp) and frames extra small (1/5 standard size). To offset this, operating periods would never last more than 45 seconds.

Well, we sweated out the high temperature problem — finally licked it with a new method of induction brazing of armature coils. Result: our coil could withstand high temperatures under all operating conditions.

Swimming suits required! Next, we had to waterproof our motors to make them swimmers. So we slipped a spun cover over each unit and sealed it against a neoprene rubber gasket. They shed water like a duck!

"On the beam" was the way those diesel engineers put it when they saw the finished product. And you should have seen the way they beamed after they made their tests. We lost a few buttons off our vests too!

There's a Moral: Every time Allis-Chalmers engineering solves *special* motor problems, we discover new ways to build better standard motors for you. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1928

Wait 'til you see the NEW

ALLIS-CHALMERS MOTORS!

HEAR THE BOSTON SYMPHONY · *Every Saturday Evening, American Broadcasting Co.*

Controlling air in proportion to **B.t.u.** input

A report on the Hagan Differential Master Method of Combustion Control

IN THE FIRING of pulverized coal the accurate maintenance of fuel-air ratio has been hampered by such factors as variation in calorific value of coal, and coal feed mechanisms which are affected by moisture content and coal size.

Since it is a known fact that the air requirement per pound of fuel is directly related to its B.t.u. content, it is possible to overcome this difficulty by a simple and *direct* method of control which for the first time employs the steam flow-air flow relationship *correctly*.

Although not universally applicable, where this relationship can be applied the Hagan differential master method uses the boiler unit itself as a calorimeter of heat input and correctly regulates the air in a positive, *direct* manner. This permits the immediate establishment and continuous maintenance of the correct conditions without relegating the principle to the position of an after correction.

By doing it right the first time there is no necessity for setting up approximate conditions to be handled by a lagging corrector system.

The successful accomplishment of this stems directly from the inherent, high speed, sensitivity and stability of Hagan apparatus.

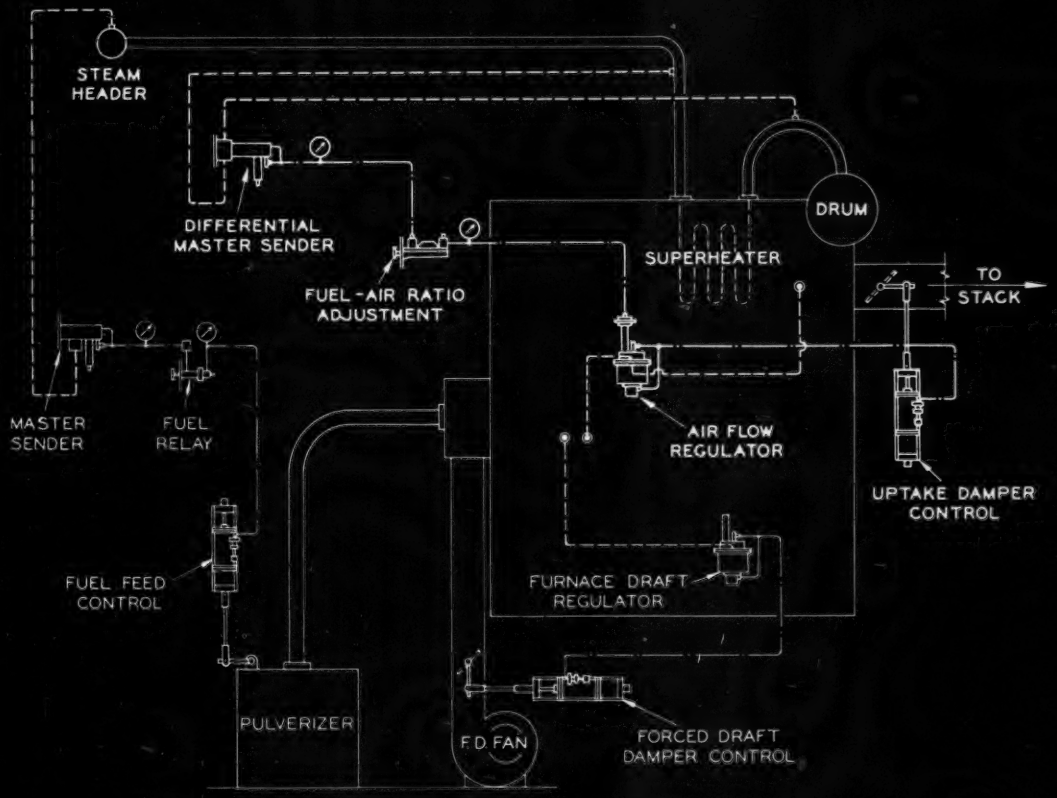
The Differential Master method has been thoroughly tested in service. In the past three years it has been applied to boilers burning oil, gas, and pulverized coal. Boiler sizes ranged from 30,000 lbs./hr. at 200 p.s.i. to 650,000 lbs./hr. at 1800 p.s.i. In every instance, results have been entirely satisfactory.

This development again emphasizes Hagan's continuing leadership in the field of automatic combustion control.

HAGAN CORPORATION, HAGAN BUILDING, PITTSBURGH 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

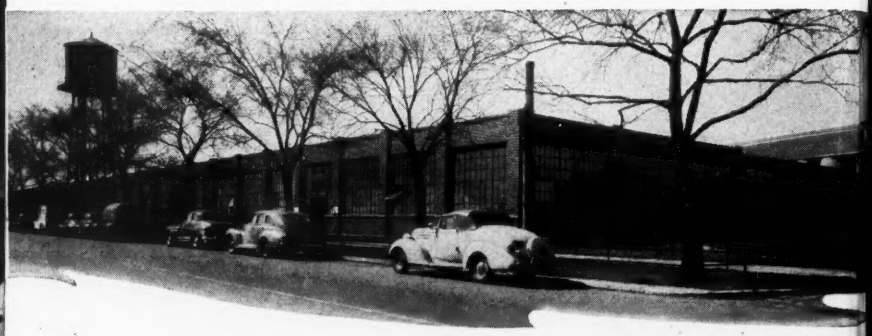


HAGAN
HALL
BUROMIN
CALGON

FUEL BILLS CUT

WITH IRON FIREMAN PNEUMATIC SPREADER ST

JOHN BROWN
General Superintendent



Transo Envelope Company plant, 3542 N. Kimball Avenue, Chicago, Illinois.

Transo Envelope Company of Chicago switches to Iron Fireman firing and saves $8440 in 1 year

THREE Iron Fireman Pneumatic Spreader stokers replaced another type of automatic firing in the plant of the Transo Envelope Company in August, 1943. Since that time fuel bills have been cut almost in half—an annual saving of more than $8,000.

ADVANCED ENGINEERING. The extraordinary record of savings reported by Iron Fireman users is adequate evidence of sound engineering. Highly efficient combustion cuts coal tonnage. Maintenance costs have been remarkably low because no moving stoker parts are subject to high furnace temperatures and all mechanism is easily accessible. In addition to this, the rugged construction characteristic of all Iron Fireman products is plainly evident in the record of Iron Fireman stokers which have been in continuous service for as long as 20 years.

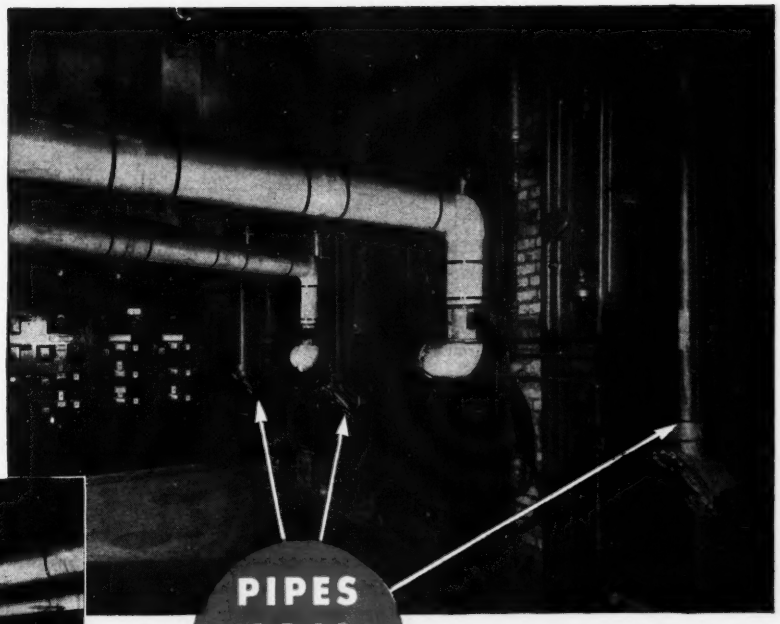
ADAPTABILITY. Because of its simple methods of firing and fuel conveying, the Iron Fireman Pneumatic Spreader has almost unlimited adaptability to existing boiler room layouts without costly remodeling.

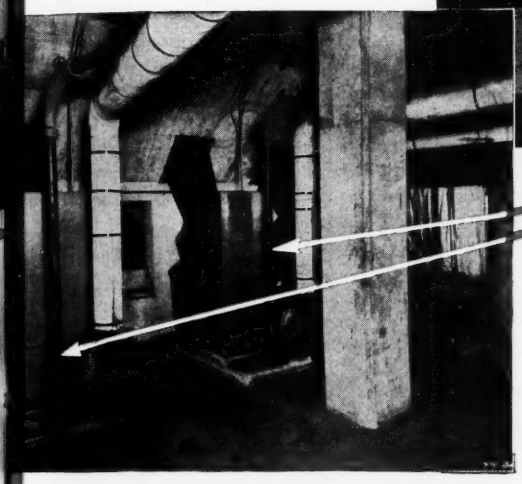
FLEXIBILITY. The Iron Fireman Pneumatic Spreader has great flexibility of operation because it is highly responsive to fluctuating loads, and because it efficiently burns a wide range of coals, including the small sizes, the low ash fusion coals as well as sub-bituminous and lignite.

Heavy Duty Automatic Coal Stoker for Power Processing and Heating

48%

STOKER

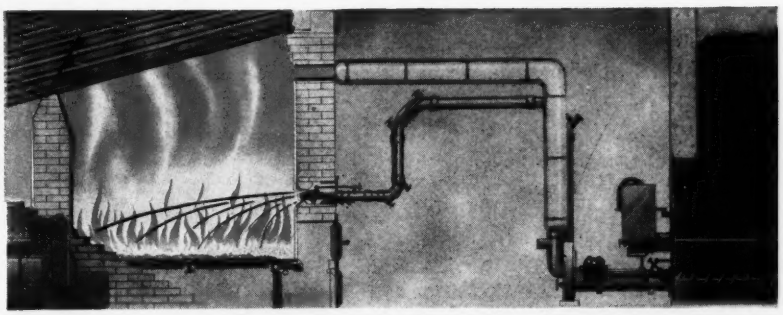




PIPES COAL TO FIRE

The accompanying pictures show Iron Fireman Pneumatic Spreader stokers in the boiler room of the Transo Envelope Company. Hot furnace gases carry coal to the boiler through the pipes indicated by arrows. Gases for this purpose are drawn from the combustion chambers through the heavily insulated pipes which are visible in both pictures. As can be readily seen, boiler fronts (above) are clear and readily accessible. At left are shown the coal hoppers which in this installation are fed from overhead bunkers. In other models the coal feeds directly from the main coal bunker or coal stock pile. Boilers can be served from bunkers or hoppers a considerable distance away, and even from different floor levels.

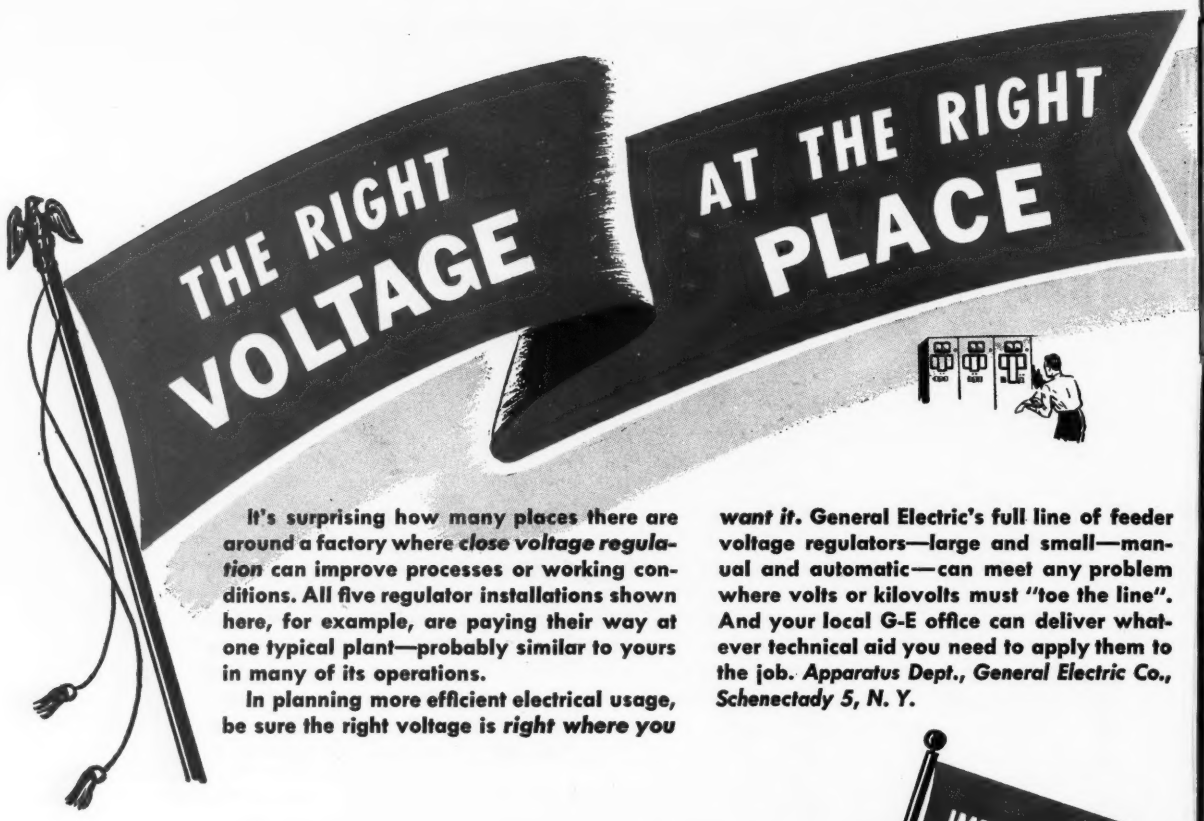
WHAT ABOUT YOUR BOILER ROOM? Are you sure your steam and labor costs are as low as they should be? Without cost or obligation you can have an accurate, impartial engineering survey of your boiler room. Write to Iron Fireman Manufacturing Company, 3275 W. 106th St., Cleveland 11, Ohio. Plants at Portland, Oregon; Cleveland, Ohio; Toronto, Canada. Dealers throughout the United States and Canada.



The Iron Fireman Pneumatic Spreader Stoker meters steam size coal from hopper or main coal bunker to transfer housing, where coal is picked up by pneumatic conveyor and delivered to furnace. The conveyor nozzle accurately spreads the larger particles of coal over the entire grate in a shallow, uniform fuel bed. The preheated fines burn in suspension, reducing the cinder carry-over and greatly improving the combustion efficiency and responsiveness, as compared with other stokers which do not preheat fuel.

IRON FIREMAN

THE IRON FIREMAN



It's surprising how many places there are around a factory where *close voltage regulation* can improve processes or working conditions. All five regulator installations shown here, for example, are paying their way at one typical plant—probably similar to yours in many of its operations.

In planning more efficient electrical usage, be sure the right voltage is *right where you want it*. General Electric's full line of feeder voltage regulators—large and small—manual and automatic—can meet any problem where volts or kilovolts must "toe the line". And your local G-E office can deliver whatever technical aid you need to apply them to the job. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

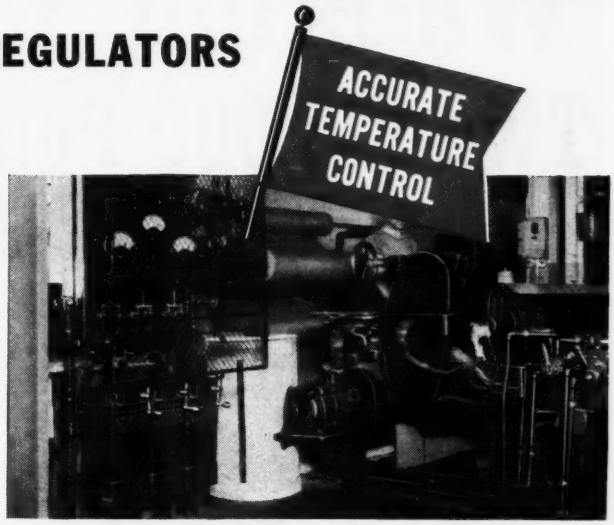
1 These dry-type induction voltage regulators are used to control temperature of a wire-annealing operation. Twelve strands are processed simultaneously, each regulator acting to control the current-flow through series-connected sections of two conductors. These hand-operated regulators make it easy to adjust for different conductor sizes and other changes in operating conditions.

2 Smooth, stepless voltage control for 100,000-volt testing equipment is provided by this 5-kva dry-type induction voltage regulator. Connected in the primary (low-voltage) side of the step-up transformer, this regulator affords 100 per cent raise-and-lower regulation, so that output test voltage can be varied from 0 to 100 kv, simply by turning the crank.

...PAYS OFF 5 WAYS AT A SINGLE PLANT

USING G-E VOLTAGE REGULATORS

3 Electric heating circuits on a hot-rolling press used to fabricate laminated plastic forms are maintained at the required temperature with induction voltage regulators. Circuits for two electrically heated rollers and one hot plate are separately controlled by the hand-operated regulators, giving close control of processing.



4 Automatic voltage regulation by means of this dry-type induction regulator has "paid off" in a more uniform level of illumination. The full visual value of every kw-hr is obtained with fewer lamp burn-outs from overvoltage. Production space is saved by locating the regulator on a platform along with the Pyranol* transformer which serves the lighting circuits.

*Trade-mark for General Electric's nonsludging insulating and cooling liquid that will not burn

5 This 48-kva Pyranol induction voltage regulator, installed in a basement substation, automatically maintains the proper voltage for lighting circuits in the plant office building. A Pyranol regulator was chosen for its safety in this confined indoor location.

For complete information on any of General Electric's voltage regulation equipment, write for the following publications:

Oil-Immersed Induction Voltage Regulators—Type IRS
GEA-2018 (24 kva and smaller)
GEA-2985 (36 kva and larger)
Pyranol Induction Voltage Regulators—Type IRS, GEA-3443
Dry-type Induction Voltage Regulators—Type AIRS, GEA-3057
Inductrols (Small Dry-type Induction Voltage Regulators) GEP-238
Automatic Voltage Stabilizers GEA-3634
Variable-voltage Autotransformers GEA-3635

GENERAL ELECTRIC

404-38-5400

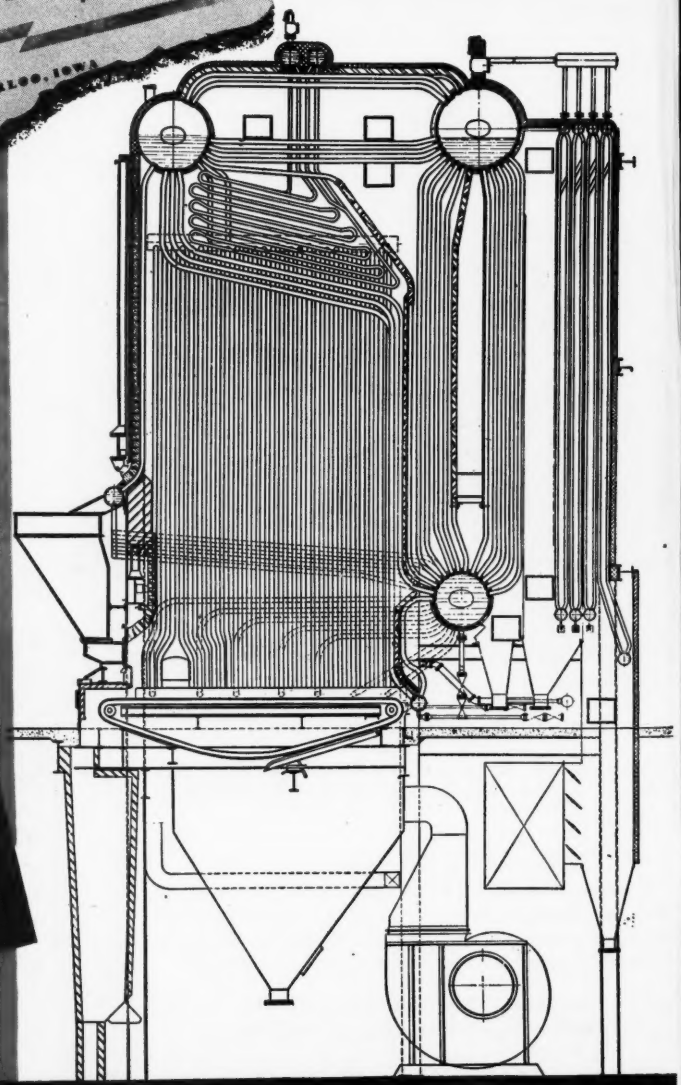
Waterloo, Ia. *Repeats*

Two 125,000 Pound Installations

1941 ····· 1945

WRITE FOR BULLETIN ON THE

DETROIT ROTOGRATE STOKERS



DETROIT STOKER COMPANY

DETROIT ROTOGRATE STOKERS

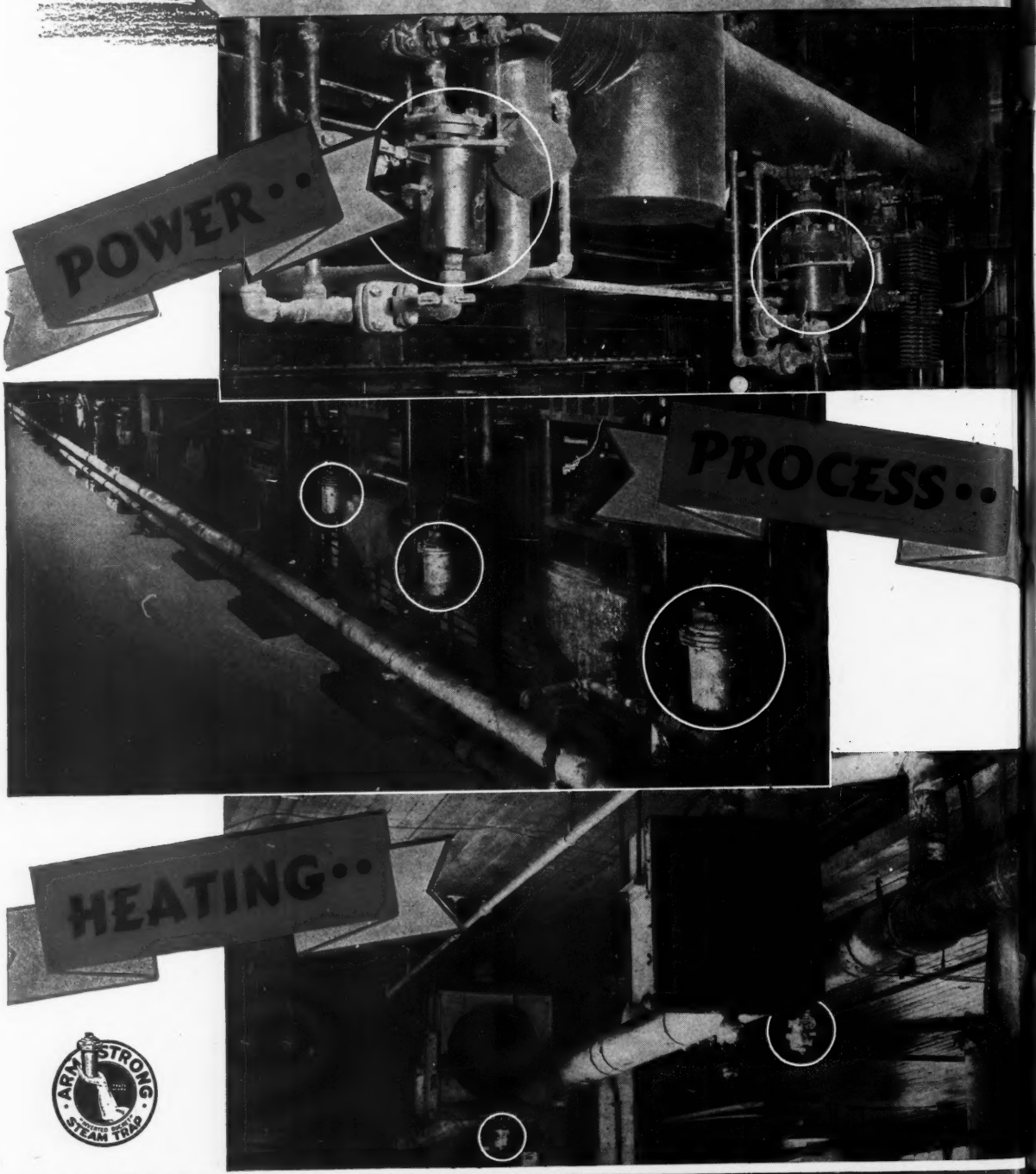
IOWA PUBLIC SERVICE COMPANY
Waterloo, Iowa

Investigate the ROTOGRATE

GENERAL MOTORS BUILDING • DETROIT 2, MICHIGAN

Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario

SOME AIDS TO THE S



ARMSTRONG *Inverted Bucke*

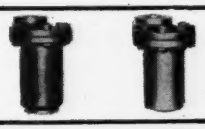
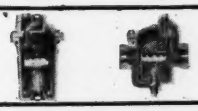
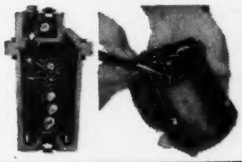
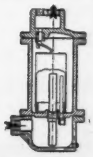
Selection of STEAM TRAPS

In planning the installation of steam traps, it is desirable to have in mind the types of traps available for various services. The chart below, describing briefly the Armstrong Traps available to meet practically any condensate requirements, will serve as a guide.

For complete data, capacity charts, prices, selection procedures, etc., send for your copy of the ARMSTRONG STEAM TRAP BOOK.

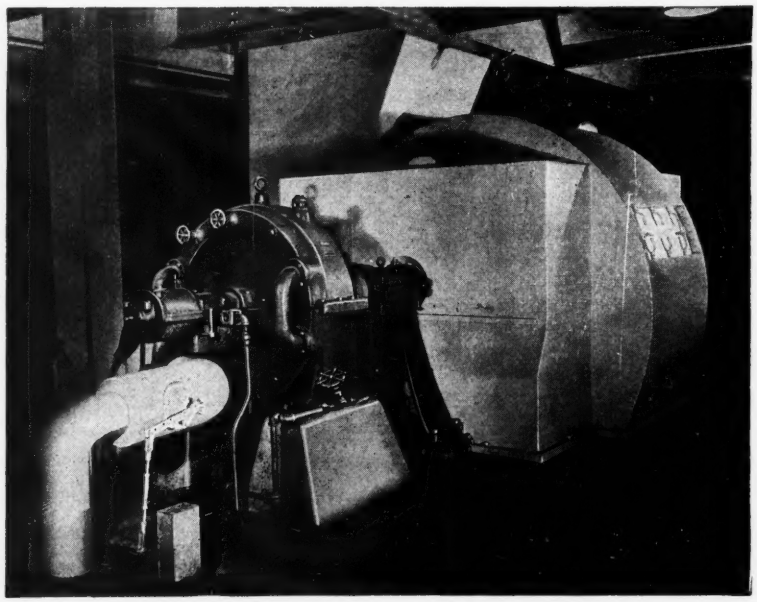
ARMSTRONG MACHINE WORKS
810 Maple Street • Three Rivers, Michigan

SAVE COAL!
Keep your traps in good repair. Ask for bulletin on trap inspection and repair.

SERVICE	TYPE OF TRAP	
1. HIGH PRESSURE or where all steel fittings are desired. (Up to 2400 P.S.I.)	Armstrong Inverted Bucket Steam Trap with FORGED STEEL body and cap. Screwed or flanged connections.	
2. MEDIUM PRESSURE — coils, kettles, headers, etc. (Up to 250 P.S.I.)	Armsrong Inverted Bucket Trap with cast semi-steel body and cap and same stainless steel mechanism used in forged steel traps. Side-inlet side-outlet or bottom-inlet top-outlet connections.	
3. LOW PRESSURE—unit heaters, coils, etc. (From 1 P.S.I. up.)	Identically the same traps, except for part sizes, as No. 2 above!	
4. WHERE LARGE AMOUNTS OF AIR MUST BE HANDLED —such as on "up-and-down" process units and low pressure heating systems. (Pressures to 250 lbs.)	Armstrong Inverted Bucket BLAST TRAPS capable of handling 500 to 1500 cu. ft. of free air per hour, depending upon bucket size.	
5. WHERE EXCESSIVE AMOUNTS OF CONDENSATE MUST BE HANDLED—steam separators, purifiers, hot water heaters, etc. (Pressures to 900 P.S.I.)	Armstrong PISTON OPERATED Compound Traps with capacities up to 300,000 lbs. of condensate per hour.	
6. WHERE PULSATING PRESSURES ARE ENCOUNTERED such as caused by reciprocating engines and pumps. (Pressures to 600 P.S.I.)	Armstrong Inverted Bucket Traps with special separating chambers.	

STEAM TRAPS for POWER PROCESS HEATING

TERRY



BUCKETS AND ROTOR IN THE TERRY WHEEL TURBINE

. . ALL IN ONE PIECE

In the Terry Turbine the wheel is made from a single forging of special composition steel. The buckets are milled directly in the wheel. There are no parts to become loose or work out. Such construction makes for long life and low maintenance.

This and many other features of Terry Wheel Turbine design are described in our bulletin S-116. A request on your business letterhead will bring a copy.

ABOVE: 250 H.P. Terry Wheel Turbine driving Induced Draft Fan. Unit is one of ten Terrys installed in a mid-western plant.

T-1153

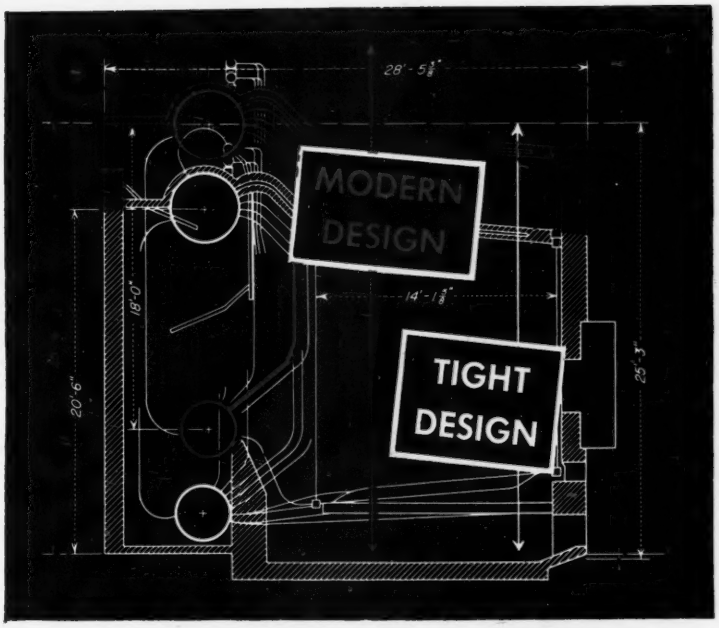
THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Defining "FLEXIBILITY"

TIGHT DESIGN–restricted fuels
MODERN DESIGN–fuel flexibility

DESIGN SPECIFICATION

The Design Specification should give the critical characteristics of typical fuels which will be economically available during the life of a new Power Plant. A leading equipment manufacturer selects Ash Softening Temperature as a controlling factor, and says, *"The basis of modern boiler and furnace design is to so proportion the furnace and cooling surface in the furnace that under average conditions of furnace wall cleanliness, the temperature of the gas entering the boiler surface will be below the ash fusion temperature."*



RANGE IN QUALITY

The Fuel Investigation develops the range in fuel quality which should be planned for. This manufacturer shows here a "tight design" requiring the use of restricted fuels, and outside of this he shows a "modern design" with a larger furnace so proportioned that a wide range of fuels can be used.

FLEXIBILITY

Sound planning requires that new or modernized power plants provide sufficient latitude to permit the utilization of the ranges of coals competitively available during their useful life. In so doing, Utilization Flexibility is achieved.

FAIRMONT COAL

The Fuel Investigation reveals that Fairmont Coal will probably be an excellent value in many markets for many, many years. Utilities and Industrials are using Fairmont Quality as the design basis for new power plants.

Designing for Fairmont Coal permits the use of a wide range of fuels. Initial investment for flexibility is somewhat higher but the additional cost can be quickly amortized and permanent savings are possible through the use of the best fuel value available.

MAIL COUPON TODAY

FAIRMONT COAL BUREAU · FAIRMONT REGION · WEST VIRGINIA · SERVICE TO INDUSTRY ·

FAIRMONT COAL BUREAU, Chanin Bldg., 122 E. 42nd St., New York 17, N. Y.

Write for Reference Bulletin No. 5 for the details on investment required for flexibility in plants requiring 400,000 lbs., 200,000 lbs., or 60,000 lbs. of steam per hour. Your request will automatically put your name on our mailing list.

Name .....

Company .....

Position .....

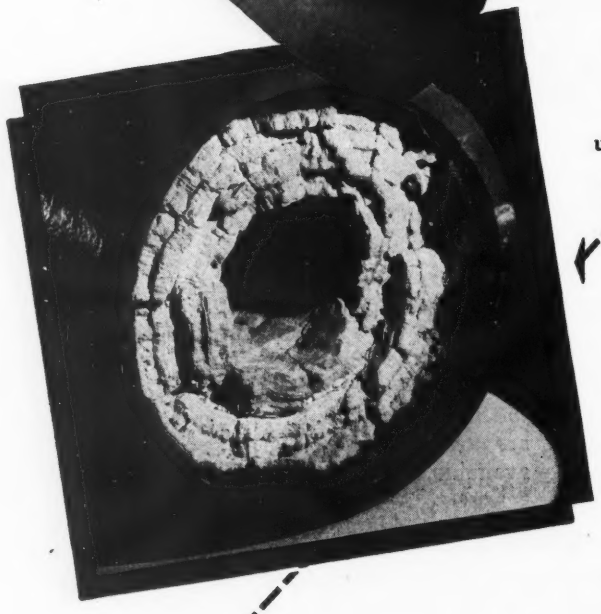
Street Address ..... *City* ..... *Zone* ... *State* .....

No—

it is not necessary to replace water lines like this!

. . says M. F. Ruley

Nalco Representative
Denver, Colorado



Down to 10% of capacity and full of rock-like scale! This water line was practically useless until it was cleaned out and kept clean by Nalco Stabilization Treatment. Obviously, there is no need to make expensive replacements when the Nalco System can be used to give you permanently scale-free lines so economically.

And scale elimination is only one phase of the complete Nalco System of scientific water treatment for all industry. A complete Nalco survey report on your plant is yours for the asking. Write today.

NATIONAL ALUMINATE CORPORATION
6224 WEST 66th PLACE • CHICAGO 38, ILLINOIS

Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Ave., Toronto, Ont.

Nalco

—The Scientific System of Water Treatment for all Industry

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILER PLANT

1 **Fuel Oil Heater**—High heat transfer, simple design, easy cleaning and other features of the Alco fuel oil heater are described in Bulletin No. 1036. American Locomotive Co.

2 **Radiant Heat From Pulverized Coal**—New KVS Bulletin No. 44-B contains 97-pg. of helpful information on steam generation through the use of air-floated pulverized coal. Kennedy-Van Saun Manufacturing & Eng. Corp.

3 **Perfect Spread Stoker**—"More Steam at Lower Cost"—an 8-pg. bulletin tells about the AE perfect spread stoker, with photographs, cross-sections and drawings. Stoker is said to burn all kinds and grades of solid fuels thoroughly, wet or dry. Completely automatic, extremely quiet operation with non-clog, variable speed feed. American Engineering Co.

4 **Steam Plant Data**—"Dividends from Your Power Plant" is the title of an interesting booklet, telling in non-technical language what engineers and plant managers ought to know about steam generation and boiler efficiency. Preferred Utilities Co.

5 **Unit-Suspended Furnace Walls**—Catalog 29 shows how Bigelow-Liptak unit-suspended walls and arches assure effective seal against air infiltration, minimum conduction losses, easy refractory replacement, low cost furnace maintenance. Bigelow-Liptak Corp.

6 **Boiler Blowdown Equipment**—"Complete Automatic Control of Boiler Water Concentration without Heat Loss" is the title of a bulletin describing Henszey continuous blowdown equipment—complete, automatic control of boiler water concentration without heat loss. Henszey Co.

7 **Hydroseal Ash Pumps**—Catalog No. 141 gives operating details, sectional diagrams, sizes, capacities and other useful handbook data on the hydrojet system of ash disposal. These pumps handle ashes from stoker-fired, dry bottom powdered coal-fired, and slagging furnaces. Allen-Sherman-Hoff Co.

7A **Boiler Feed System**—Folder describes the Morehead direct pressure liquivator for boiler feeding. Advantages claimed: cannot become steam bound; not affected by high temperature flash; increase heat transfer, speed production. Morehead Mfg. Co.

ELECTRICAL

8 **Hints on Wiring Maintenance**—A practical working program to keep your electrical system in condition is outlined in a Preventative Maintenance book issued by Anaconda Wire & Cable Co. Also contains wiring diagram symbols, hints on motor selection, routine tests, etc.

9 **Pyranol Capacitors**—"Engineering Aspects of Pyranol Capacitors in Large Banks" is the title of new 20-pg. Bulletin GEA-4225. Covers basic principles of system kvar requirements, application problems, installation data. General Electric Co.

10 **Low Speed Synchronous Motors**—Compactness, accessibility, good line power factor and other advantages of Elliott synchronous motors, operating at speeds of 450 rpm and below, are covered in new file size bulletin. Also gives detailed views of major construction features. Elliott Co.

11 **Fiberglas Electrical Insulation**—How glass in fiber form provides high tensile strength, moisture and insulation resistance and other desirable characteristics is brought out in new 24-pg. Fiberglas handbook. Contains many charts and application photos on wires, tapes, mica combinations. Owens-Corning Fiberglas Corp.

12 **Lighting Maintenance Tips**—New booklet has illustrations and check charts on how to get more light at no extra cost, cleaning, inspection, painting, easy test methods. Covers various types of lamps in industrial plants. Westinghouse Electric & Mfg. Co.

13 **Cartoon Booklet on Electronics**—The Electronic Corporation of America has announced a 36-pg. booklet. The Amazing Electron, for distribution to engineers, consumer organizations, and the general public. Illustrated in cartoon technique, and simply written, the booklet is intended to give everyone the basic facts about electronics. Also describes many applications.

14 **Electric Motors**—Star Electric Motor Co., 8-pg. file-size, condensed catalog bulletin (printed in Spanish and Portuguese as well as English) presents specification and descriptions of standard star motors and generators. Illustrations show many typical applications in hoists, comminutors, canning machinery, Diesel generators, dry-cleaning machinery, printing equipment, machine tools, and other equipment in which severe service conditions are encountered. Specifications and load capacities are included for squirrel-cage induction motors ½ to 200 hp; wound-rotor induction motors ½ to 200 hp; d-c motors 1 to 200 hp, and design features of Star gearmotors and brakemotors.

FANS, PUMPS, COMPRESSORS

15 **Centrifugal Blowers**—Eclipse Fuel Engineering Co. Sheet No. K-901 describes McKee centrifugal blowers for supplying pressure air to combustion equipment.

16 **Compressed Air Purifiers**—Bulletin No. 10 describes new Pur-O-fier for eliminating free moisture, oil, and foreign matter in small compressed air system. Bird-White Company.

17 **Centrifugal Pump Manual**—Conveniently tabbed file-size catalog describes Weinman Unipumps for general service, split-case centrifugal pumps, non-clog pumps, sump pumps, etc. Includes useful pump instruction manual and hydraulic engineering data. The Weinman Pump Mfg. Co.

18 **Centrifugal Pump Control**—Reprinted in 28-pg. folder are the six useful articles on Centrifugal Pump Control written by Ignor Karassik and published in Power Plant Engineering. Deals with characteristics of centrifugal pumps, basic operations of pump controls, types used, etc. A valuable reference for all plant engineers. Worthington Pump and Machinery Corp.

19 **Forced Draft Blowers**—Condensed bulletin, covering Wing forced draft blowers, both turbine driven and motor driven, and Wing Auxiliary Turbines, has been issued by L. J. Wing Mfg. Co. Information includes photographs of installations, capacity curves, dimension tables and operating data.

20 **Pumps For Dry Cleaning**—The Blackmer Pump Co. Bulletin No. 118, entitled "Pumps for the Dry Cleaning Industry," features a belt-driven pump for handling liquids used in dry cleaning operations. Although Blackmer pumps have been used in dry cleaning plants for many years, this is the first Blackmer unit designed especially for this type of application.

21 **Instruction Sheet For Eco Pumps**—The Eco Engineering Co., has issued an illustrated instruction sheet describing the installation and operation of ECO gearless pumps as used for water and oil circulating. The sheet includes pump dimensions, capacity charts, prices and several typical methods of pump coupling.

INSTRUMENTS AND CONTROLS

22 **Governors**—Allis-Chalmers Mfg. Co. 24-pg. bulletin No. B6356 discusses centralized control provided by modern governors for large hydroelectric units.

23 **Gas Testing Apparatus**—The Refinery Supply Co., has a new Catalog No. 30-A on Gas Testing Apparatus. It fully describes such equipment as: Recording Gravitometer, Gas Gravity Balances, Dew-Point Tester, Vapor Pressure Bomb, Specific Gravity Bomb, Dead Weight Testing instruments, Pulsameter, Etc. Giving specifications and prices.

24 **Automatic Coal Scales**—Catalog 1143 contains illustrations and technical data on a line of dustproof coal scales which will furnish precise figures on coal consumption, steam cost and boiler efficiency. Richardson Scale Co.

25 **Smoke Indicator**—Folder describes the Diamond smoke indicator which enables fireman to see flue gases without leaving the floor. May be applied on any boiler; does not interfere with dampers: has no moving parts. Diamond Power Specialty Corp.

26 **Motor Controls**—Electron Equipment Corp. 4-pg. bulletin No. 178 gives operating features and applications of electronic motor controls.

26A **Pump Governors**—The complete line of Williams equipment for power plants is described in a 24-pg catalog No. 449. Among items covered are Williams-Hager flanged silent check valves, Williams steam pump governors, steam operated traps, high and low alarm water columns, water gages, safety feedwater regulators. Each product is illustrated and diagrammed; tables show the entire range of sizes and complete specifications. The Williams Gauge Co.

MECHANICAL TRANSMISSION

27 **Reconversion Inventory of V-Belt Drives**—Handy check list for each machine shows: 1. Present condition of drive; 2. Condition of belts; 3. Condition of sheaves; 4. Drive engineering; 5. Belt engineering. Offers practical tips on correcting scuffing, slip burn, oil swelling and abrasion. Allis-Chalmers Mfg. Co.

28 **Spiral-Bevel Speed Reducers**—Bulletin 200 gives design features, hints on selecting proper units, table of load characteristics, horsepower ratings and other helpful handbook data on Philadelphia spiral-bevel speed reducers. Also pictures typical installations. Philadelphia Gear Works, Inc.

29 **Belting Reference Chart**—New transmission and conveyor belting chart provides a rapid reference for standard belt thicknesses and includes full information as to fastener and lacing sizes for each thickness. All commonly used belting materials are covered—leather, cotton woven, canvas and balata, rubber, etc. Baldwin Belting, Inc.

30A **Bearing Metals**—8-pg bulletin gives many helpful hints on how to keep bearings on the job and shows what bearing metal to use for every application. A useful reference for operating and maintenance men. Magnolia Metal Co.

Coupon must be filled in completely to secure literature your request. Pasting coupon on penny postcard saves time and money.

FEBRUARY, 1948

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30 **Transmission Belting**—A new catalog section on transmission belting has been published by the B. F. Goodrich Co. Featured is Highflex, which was the first successful square edge, foldless hard duck transmission belt when it was introduced in 1925. Details of the manufacturing and testing program for each foot of this belt are given, as well as its advantages in service.

PIPING, VALVES, FITTINGS

31 **Underground Pipe Conduit**—Bulletin 451, entitled "Therm-O-Tile, the conduit for "Underground Pipe Lines," covers its four main advantages: (1) Keeps underground pipe insulation dry. (2) Holds grade of the piping permanently. (3) Has greater strength than is required by the American Society of Testing Materials. (4) It is competitive in initial cost. H. W. Porter & Co.

32 **Data Book on Welding Fittings and Forged Steel Flanges**—Catalog gives useful information on welding fittings and forged steel flanges. Contains engineering data for the man who purchases, designs or specifies piping, fittings and flanges. Taylor Forge & Pipe Works.

33 **Flexible Pipe Joints**—Bulletin describes Flexo joints used wherever flexible or swing pipe joints are required for conveying steam, compressed air, water, oil, and other fluids under high or low pressure. May also be used on suction lines. These joints will swivel through 360 deg., with no restriction in flow. Flexo Supply Co.

34 **Corrosion and Abrasive Proof Diaphragm Valves**—Bulletin describes McAlear corrosion-proof diaphragm valve. Available in 10 sizes, ½ in. to 6 in. screwed or flanged, in semi-steel or lined with rubber, glass, or lead. Automatic Control Div., Climax Industries.

35 **Tube Cleaning Suggestions**—Correct steps in a tube-cleaning operation to insure highest efficiency are outlined in a new service bulletin by Thomas C. Wilson, Inc. Information covers selection of appropriate equipment, proper cleaning procedure, care of cleaning equipment, and listings of types and sizes of motors, cutters, brushes and other accessories required.

36 **Weld in Piping and Pressure Vessels**—Bulletin describes the Westport patented joint which permits fusion butt-welded joints to be made from one side only. Provides greater flexibility in alignment of pipe, complete penetration to root of weld and other advantages. W. K. Mitchell & Co.

37 **Cast Steel Gate Valves**—Large diameter handwheel close fitting guide ribs, hard faced seats and other trouble-proof features of the new Edward gate valve are pictured in Catalog No. 12-E. Edward Valves, Inc.

38 **Guide for Pipe Users**—A new 56-pg. catalog, featuring application of light-weight pipe in diameters from 4 to 30 in., has just been issued by the Naylor Pipe Co. Installation photos show application of Naylor Lockseam Spiralweld pipe in fields in which light-weight pipe is used to advantage. Along with valuable data on pipe structure are sections on precision fabrication and pipe connections including an entirely new type of coupling which saves time and labor for users.

WATER TREATMENT

39 **Boiler Water Conditioning**—Bulletin 1713 describes a working principle to mechanize boiler water conditioning, and improve heat transmission, save fuel, and reduce shut-downs for repairs and cleaning. Proportioneers Inc.

40 **Water Analysis Methods**—Nalco bulletin No. 6-A furnishes information on standard methods of water analysis and interpretation of results. Tells how to make field survey or rapid check tests and rapid laboratory tests, listing reagents used. National Aluminate Corp.

41 **Double-Check Zeolite Softener**—Elgin Softener Corp., in Bulletin 606, describes an improved water softener which, compared to others of equal size, is said to give up to 44 per cent more soft water. Equipped with new manifold arrangement which prevents loss of zeolite.

42 **Chemical Feed Systems**—Bulletin 451 explains why two distinct systems are recommended, for feeding Sodium Sulfite into feed water lines and for feeding other chemicals directly into the boilers. It lists the various units by code number, by boiler pressure, by make-up water requirements, etc., so that the power plant engineer may select a unit of proper capacity, get a quotation, buy and install just as he does an electric motor, a new pump or some other piece of equipment. Milton Roy Pumps.

43 **Ion Exchangers**—Bulletin No. 1960 describes the action of Infilco ion exchangers which utilize principle of ion exchange of sodium for calcium and magnesium, hydrogen for other metallic ions present, etc. Many flow diagrams, installation photos and data useful to water treatment engineers. Infilco, Inc.

WELDING

44 **A Reference Chart on Alloy Welding**—A new and unusual reference chart on high and low alloy welding electrodes has just been announced by Arcos Corp. Data includes tables on corrosion resistance, on heat resistance, and on weld metal surfacing, as well as the chemistry of the weld metal. Welding current and voltage tables give information of value to the operator. Chart is 20 in. by 30 in. for wall mounting.

45 **Chart Lists Welding Electrode Properties**—Wall chart DH-1314 will prove helpful in the welding shop as well as in the office of the welding engineer. It gives the chemical and physical properties of all of the Page welding electrodes and gas welding rods. A tremendous amount of welding data is clearly condensed and arranged for easy fact-finding. The chart is large, 17 in. by 25½ in. for hanging but it will easily fold down for filing away in a desk drawer. Page Steel & Wire Div., American Chain & Cable Co. Inc.

46 **AC Arc Welding Booklet**—New Wilson "Bumblebee" a-c transformer arc welding machines are described fully in a 16-pg. illustrated booklet just published by Air Reduction. Described are the 300 and 500 amp. standard and all-weather models, and the new 200 amp. "Bumblebee," to meet the demands for a small arc welder. Additional sections are devoted to small transformer type a-c welders, running gear, remote control, shielded arc electrodes, engineering data and specifications are labeled.

46A **Welder's Guide on Hard Facing**—Practical methods of welding a hard wear-resistant metal to surface of softer metal are described in latest edition of Welder's Guide To Successful Hard Surfacing. Also lists many types of industrial equipment on which hard facing applications are used. Mir-O-Col Alloy Co.

MISCELLANEOUS

47 **Central Vacuum Cleaning System**—Bulletin 125 describes Spencer centrally located vacuum producer and dirt separator; piped to valves placed on each floor; flexible hose and vacuum tools for all kinds of industrial cleaning and material reclaiming. The Spencer Turbine Co.

48 **Magnaflux Field Inspection**—New illustrated bulletin tells all about Magnaflux field inspection service. Guards against plant shutdowns by detecting flaws in boilers, engines, pumps, etc., before serious trouble develops. Magnaflux Corp.

49 **Spray Nozzles for Water Cooling**—Bulletin N-616 describes construction features and advantages of Yarway spray nozzles for water cooling, air conditioning and general industrial uses. Contains suggestions for designing spray ponds; photos of spray characteristics, capacity charts and other useful engineering data. Yarnall-Waring Co.

50 **Heat Insulation Handbook**—The Ehret heat insulation handbook contains a wealth of information on 85% Magnesia, Enduro high temperature and many other insulations—with selection and application data for boilers, piping and equipment. Fully illustrated, it includes heat loss and efficiency tables, specifications and recommendations for every temperature condition. Ehret Magnesia Mfg. Co.

51 **Heater Applications**—Bulletin No. 200 describes operating features and pictures applications of Alberger heaters, heat exchangers, and related equipment. Also gives dimension and capacity tables. Alberger Heater Co.

52 **Sectional Heat Insulation**—Bulletin No. 48-974 describes the efficient performance and easy handling of Unibestos, the sectional heat insulation. Saws or cuts clean with ordinary tools. Also gives step-by-step picturization of application of Unibestos. Union Asbestos & Rubber Co.

53 **Centrifugal Refrigeration**—New 24 pg bulletin discusses cycle of operation, refrigerants, load characteristics and other features of Worthington Centrifugal Refrigeration. Also lists and pictures typical installations in many industries. Worthington Pump and Machinery Corp.

54 **Instruction Cards on Fire Extinguishers**—A new series of concise, comprehensive instruction cards, explaining the operation and maintenance of four of the most widely used types of hand fire extinguishers, has been prepared by American-LaFrance-Foamite Corp. They cover the Foam, Soda-Acid, Vaporizing Liquid, and Carbon Dioxide types. Clear illustrations accompany the text and show the various steps to be taken in handling, operating, and maintaining the extinguishers.

55 **Low Level Jet Condensers**—Bulletin W-204-B10 gives operating features and capacities of Worthington low level jet condensers. Mounted on horizontal single wet vacuum pumps; suited for small steam engine, small turbine or process applications. Worthington Pump and Machinery Corp.

56 **Conveyor Belt Guide**—The B. F. Goodrich Co. has issued a new "Guide to the Selection of Conveyor Belt Grades." Discusses differences in various grades; outlines reliable measurements of qualities in various type belts and the services for which they are commonly applied. Description and data, as well as ordinary uses for each of its conveyor belt grades are also contained in the guide.

57 **High Pressure Return System**—The Cochrane Corp. publication 3250 describes their new high pressure condensate return system which has been creating favorable reactions from process engineers. Benefits include establishment of higher heat transfer rates, of definite uniformity and more heat from the same pressure of steam complemented by less fuel costs and increased boiler capacity.

58 **Handbook of Hack Saw Care**—Selection of proper blades for cutting various metals, causes and cures of common blade difficulties, and hints on "how and how not to do it," are featured in a new 30-pg. illustrated booklet offered by Clemson Bros., Inc. Entitled "Metal cutting," this pocket-size booklet includes data on both hand and power blades, and except where text states otherwise, the recommendations apply to blades of all manufacturers.

59 **Tips on Fire Fighting**—Booklet "How to Make Fire Kill Itself" describes extinguishing properties of carbon dioxide, outlines advantages of Kidde built-in system and portable extinguishers, tips on protecting electrical equipment, etc. Walter Kidde & Co.

60 **Oil Clarifiers**—Briggs Clarifier Co., Washington 7, D. C., 36-pg booklet G, F, DFR, DR and DRU series oil clarifiers and ZR series oil filters. Article entitled "Continuous Lube Oil Maintenance," by Walter C. Bauer, is included in booklet.

61 **Evaporators and Heat Exchangers**—Described in new 8-pg. bulletin are various types of evaporators, heat exchangers, extraction columns and other process equipment made by Union Iron Works. Diagrams show typical installations in process industries.

62 **Data On Welded Floats**—Bulletin No. 345 describes Nicholson welded floats, sizes 2 to 14 in. diameter, for pressures from vacuum to 3000 lbs. Used for dairy, cannery, chemical and steam specialty equipment. Bulletin has dimension tables, volume and buoyancy data, other useful information. W. H. Nicholson & Co.

63 **Packing Recommendation Charts**—Belmont's Packing Recommendation Charts provide handy tips for maintaining stuffing boxes in water, steam, oil and gasoline service. Also describe the complete line of Belmont packings. The Belmont Packing and Rubber Co.

64 **Improved Floor Cleaner**—Folder tells about Maintenex, a crystal cleaning powder for factories, dairies, department stores and other buildings with heavy traffic. Fluorescent color indicates correct dosage; dissolves in hot or cold water; emulsifies dirt rapidly. A. C. Horn Co.

65 **Insulating Cement Handbook**—Baldwin-Hill Co. has just released a new 4-page, fully-illustrated folder on their B-H No. 1 Insulating Cement. This 8½ x 11 folder provides factual information, tables and charts on the efficiency, coverage and ease of application of the product, which is described as the all-purpose thermal insulation.

66 **The Technical Service Department** of National Cylinder Gas Co. has issued an illustrated circular covering the "how to" on the cutting of cast iron with the oxy-acetylene flame. Included is discussion of proper types of equipment, pre-heating conditions, cutting positions, need if adequate protective clothing, proper oxygen and acetylene pressures, etc.

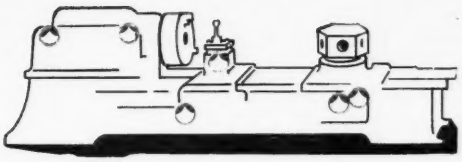
1 CODED 2 LUBRICATION

tells your oilers 4 important facts... with simple numbers

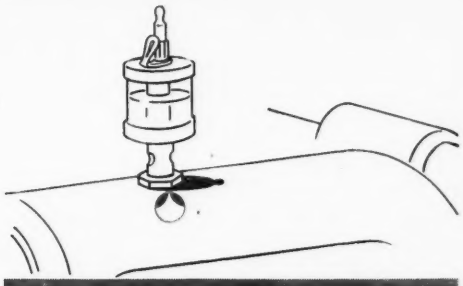
TROUBLED with getting the right lubricants in the right places? Standard's Coded Lubrication Service can help you. And it's easy to install and simple to follow.

Code numbers, not colors, are assigned to each lubricant used in your plant. Numbered decals are applied at each point to be lubricated, indicating which lubricant is to be applied. Every grease gun, oil can and storage container is numbered to indicate what lubricants are in them. Your oilers simply follow the numbers without having to remember brand names and grades.

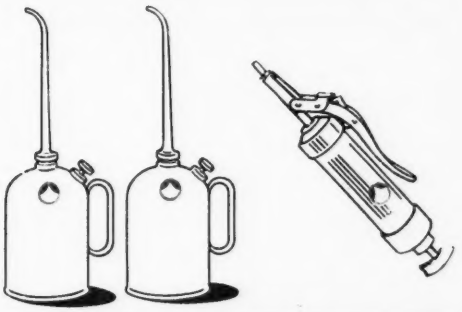
A Standard Oil Lubrication Engineer will be glad to discuss the application of Coded Lubrication in your plant. Call the nearest local Standard Oil office or write 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.



1. Where lubricant is needed



2. Which lubricant to use



3. Which oil can or grease gun to use

4. Which lubricant is in each storage container

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

Class	Type	Kind of Soap	Upper Temp Limit	Characteristics
Lime Soap (Calcium)	Cup	Lime fat	175° F.*	Smooth, water resistant, separates on boiling out water content, limited consistency loss on working.
	Axle	Lime rosin	150° F.	Smooth, sticky, water resistant, separates on boiling out water content, great consistency loss on working.
Soda Soap	Fibre and Sponge	Soda fat	375° F.	Fibrous, not water resistant, does not separate at elevated temperatures, variable consistency loss on working.
	Medium and Short Fibre	Soda fat	375° F.	Semi-smooth, not water resistant, does not separate at elevated temperatures, variable consistency loss on working.
	Smooth (block, brick)	Soda fat (variable soda rosin content)	400° F.	Smooth, hard, not water resistant, does not separate at elevated temperatures.
Aluminum Soap	— — —	Aluminum fat	240° F. (average)	Smooth, gel-like or stringy, water resistant, becomes fluid at elevated temperatures, limited consistency loss on working.
Compounds	Residuum	Usually none	— —	Smooth, black, adhesive, excellent pressure and water resistant.

*As high as 200° F. for special lime soap greases where such maximum temperature is intermittent.

To get longer life from bearings

(1) Use the right grease

The difficulties of choosing the right type of grease for any particular application are demonstrated in the table above. This lists the general operating characteristics of the more common types of grease. In addition, each type comes in many grades and all have advantages for specific grease lubricating jobs.

Many plant men have given up trying to guess their way through this maze. They know that Standard Oil makes all types of grease. They've found that Standard Oil Lubrication Engineers are qualified by training and experience to analyze operating conditions and fit the right type and grade of grease to the job. But the right grease is only half the problem. The other is:

(2) Good Maintenance Practices

The proper functioning of even the best grease in a bearing depends upon many factors such as condition of seals, bearing alignment and lubricant application, to name a few. A common tendency, for example, is to apply too much grease to anti-friction bearings. This results in excessive churning of the grease, undue friction and leakage.

Here again a Standard Oil Lubrication Engineer can help you by determining the cause of bearing or lubricating failures. Put your lubricating problems into the hands of one of these Lubrication Engineers. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Ill., for the Engineer nearest you.

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

this flexible metal hose resists . . .

HIGH TEMPERATURE
REPEATED FLEXING
HIGH PRESSURE
CORROSION
VIBRATION

The flexibility of rubber . . . **plus the all-'round stamina of Monel, Nickel and Inconel** . . . is yours when you use flexible metal hose made by Eclipse.

The hose carries steam, corrosive fluids and gases. In some of the smaller diameters, test pressures up to 3000 p.s.i. have been applied with safety. And, with Inconel flexible hose now being successfully produced experimentally, the temperature ceiling has been raised to 2000° F.

The well-known strength, heat and corrosion resistance of Monel, Nickel and Inconel permit you to use the hose in numerous ways: *as steam run-in leads to machines or presses . . . to carry away exhaust from gasoline or Diesel engines . . . as a carrier for remote control cables . . . as electric wire armor in corrosive or high-temperature locations . . . as connectors in air-conditioning or refrigerating equipment.*

The tubing is absolutely leakproof, for it is really a seamless metal tube that has been compressed into a series of bellows-like corrugations.

With corrugations deep, parallel, and rounded at top and bottom, the tubing is highly flexible.

Diameters as small as ⅛" are available.

If you've been bothered by rubber or soft metal tubing that can't "take" it, investigate all-Monel all-Nickel or all-Inconel flexible tubing. For more information, write the manufacturer: Metal Hose Dept., Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall St., New York 5, N.Y.

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*Reg. U. S. Pat. Off.

The FACTS on Boiler Water Conditioning

were not found in the textbooks

Digging up facts before they get in the textbooks is an old habit with Hall Laboratories—and it is a habit that has been of the utmost importance to every boiler plant operator.

Hall started that way twenty-four years ago, when they tossed theory aside and learned by careful experiment just what actually happens in a boiler, how scale is formed and deposited, and how it can be prevented. Today, the facts discovered at that time *are* in the textbooks, and the basic principle of the Hall system—maintenance in the boiler water of certain essential chemical equilibria—has met with practically universal acceptance.

The establishment of this principle was one of the most important steps ever taken in boiler water conditioning, but to Hall chemists it was only a starting point. Continuing their study of chemical reactions *at the temperatures and pressures encountered in steam boilers*, they brought about the use of phosphates in boiler water conditioning.

That, too, was a great step forward, and led to the creation of a new phosphate, developed from a sodium phosphate glass which had been neglected for nearly a century.

Fundamental research in factors pertaining to boiler water conditioning has been continued through the war, and it will remain an integral part of the work of Hall Laboratories. This continuous research is your assurance that they will always be ready to meet new problems created by changes in operating conditions and advances in boiler design.

Every plant that generates its own steam can profitably use Hall service, for Hall service *keeps boilers on the line.*

Write for full information.

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HALL SYSTEM *of Boiler Water Conditioning*

Here's what Hall Clients get:

1. Thorough study of all factors concerning water involved in producing steam.
   Boiler temperatures, pressures and ratings, boiler design, and other factors must be taken into consideration—not merely the constituents of the feed water.

2. Procedure for the proper treatment of boiler water.
   A definite program of treatment to maintain the required chemical equilibria, plus instruction for frequency of blowdown and other matters related to proper functioning of the boiler.

3. Instruction of designated employees in making of essential control tests.
   When proper conditions have been established, they must be maintained, in spite of variations in feed water and changes in operating conditions. Any boiler operator can, after instruction, follow the simple test routine developed by Hall chemists.

4. Periodic check up by Hall service engineers.
   Experience in hundreds of plants is brought to your plant by these men, and often enables them to detect conditions that might otherwise be overlooked.

5. Periodic checking of samples by Hall Laboratories.
   This is your assurance that testing at the plant is being carried out according to instructions.

6. "Trouble shooting" as problems arise.
   If trouble does occur, Hall engineers are prepared to trace it to its source, and give all possible help in correcting it.

PLUS the assurance that you not only have the most effective system of boiler water conditioning yet devised, but also that new developments in this field will be available to you as soon as their value has been established under actual operating conditions.

HAGAN
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CALGON

Two Clues

to Why A-C's Smooth-Running Electrifugal Pump is the Finest of its Kind!

Clue No. 1: One-piece shaft carries motor-rotor and pump-impeller on ball bearings—assures alignment and smooth operation. Cast bronze sleeve shields it from liquid being pumped.

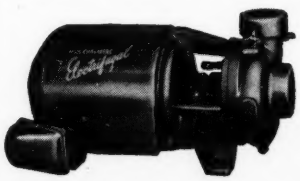
CLUE No. 2: One-piece iron casting forms motor yoke, the bearing housing, pump bracket and feet—gives stability to entire unit. Saves 33% space, lessens chance of strain on parts or piping.

FINE ENGINEERING adds up to quality and value—and that's what Allis-Chalmers "Electrifugal" Pump now offers you! Entire unit is designed for efficient, dependable service—gives you maximum protection against dangers of abnormal wear, leakage, corrosion, vibration. For further information call our nearby office, or write ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN. A 1929

HEAR THE BOSTON SYMPHONY: *Every Saturday Evening, American Broadcasting Co*

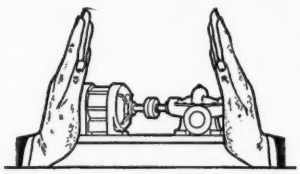
OIL COMPANY BUYS 100 *Electrifugal* PUMPS

TO MOVE volatile liquids such as gasoline, kerosene, naphtha from tank-car to storage tank, and into trucks—a large petroleum company depends on A-C Electrifugal Pumps. Try-out of first 15 pumps was so successful (big test: surge-shock when valves snap shut!), 100 units were ordered, more later re-ordered.

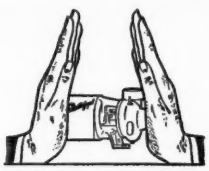


Electrifugal Capacities: 15 to 1600 gpm—heads up to 500 feet.

SQUEEZE PLAY CUTS PUMP SPACE 33%



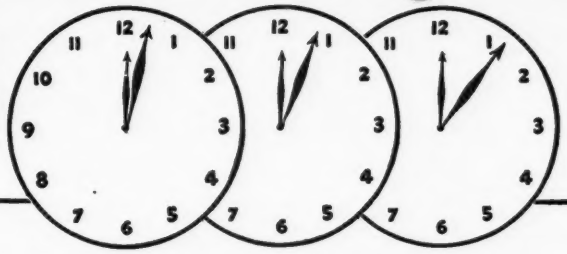
How can we couple a pump and motor together *better*—to save space, provide stability, rigid alignment?



Electrifugal Design assures alignment and smooth operation, cuts space 33% — gives you greater pumping efficiency for your money!

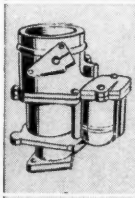
ALLIS-CHALMERS *Electrifugal* PUMPS

How to Cut Metal Cleaning Time to MINUTES



NEW, FAST-ACTION DETERGENT CLEANS FERROUS AND NON-FERROUS METALS...Easy to Handle

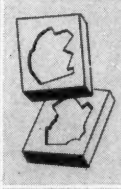
TYPICAL USES FOR Solvent "26"



CARBURETORS—Solvent "26" removes gum, gasolene, sediment and other accumulations of dirt.

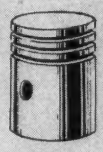
SPARK PLUGS—Solvent "26" safely cleans porcelain; helps loosen carbon deposits.

METAL PLATES AND SCREENS—Solvent "26" restores clear, clean finish to any metal surface.



DIES AND STAMPING—Solvent "26" removes drawing compounds from die-formed or stamped metal.

LABORATORY EQUIPMENT—Solvent "26" frees glass and metal tubing and their supports of gums, varnishes and other incrustations or deposits.



PISTONS—Removes lacquers, gums, resins, etc. from gas, gasolene and diesel engine pistons and rings. Also effective for cleaning all parts of dismantled motors, engines and machinery.

REMOVES:

Oil • Grease • Gums • Varnishes • Lacquers • Paints
Carbonaceous Deposits • Asphaltic Products

FROM:

Steel • Cast Iron • Aluminum • Porcelain • China
Chrome and Nickel Plate • Stone • Precious Metals
Brass • Washable Fabrics

Used throughout the war in critical industry as a superior cleaning agent, newly-developed SOLVENT "26" is now available for all industrial needs.

Offering many advantages in time, labor and cost over other present cleaning methods . . . Solvent "26" is so effective a detergent it can be used at *ordinary* room temperatures.

The fast action of Solvent "26" reduces cleaning time from hours to minutes on dismantled engine parts and all kinds of machinery. Simply dip, rub, brush or spray it on. Then flush clean with hot water.

Mail the coupon today for literature and information leading to a demonstration of this unique product in your own plant.

CITIES SERVICE OIL COMPANY
ARKANSAS FUEL OIL COMPANY

CITIES SERVICE OILS
ONCE-ALWAYS

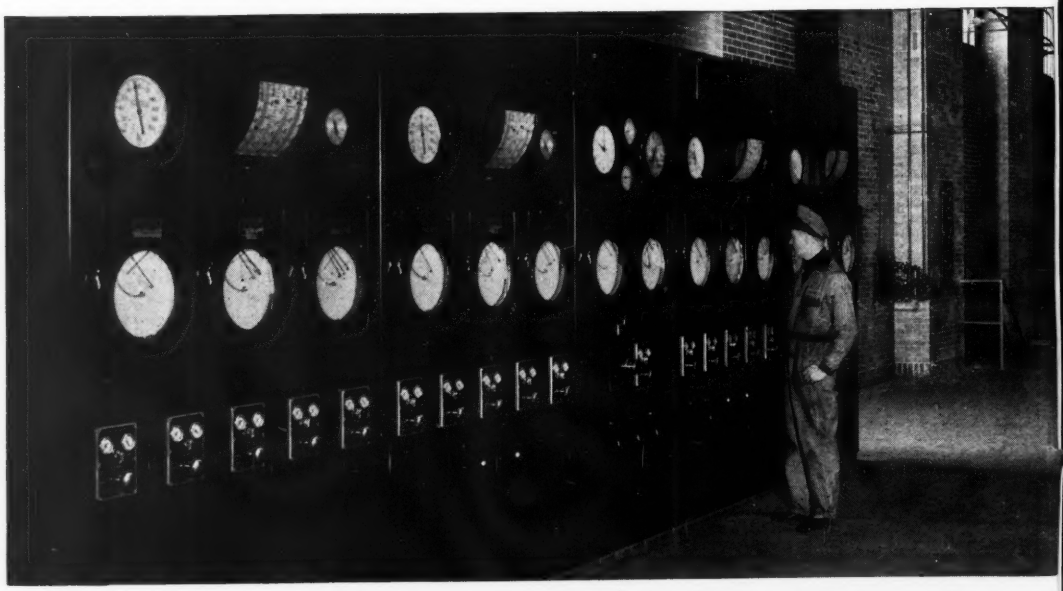
Cities Service Oil Company
Room 643
70 Pine Street
New York 5, N. Y.

Gentlemen: I am interested in a demonstration of Solvent "26"—at no cost or obligation.

Name.....
Title.....
Company.....
Address.....
City.....State.....

HOW DOES YOUR BOILER PLANT RATE ON *THESE* POINTS?

1. Continuity of service.
2. Evaporation ratio.
3. Safety of operation.
4. Peak steaming capacity.
5. Utilization of available manpower.



This Bailey Boiler Control Panel continuously maintains Optimum Performance in a central heating plant.

BAILEY METER CONTROL

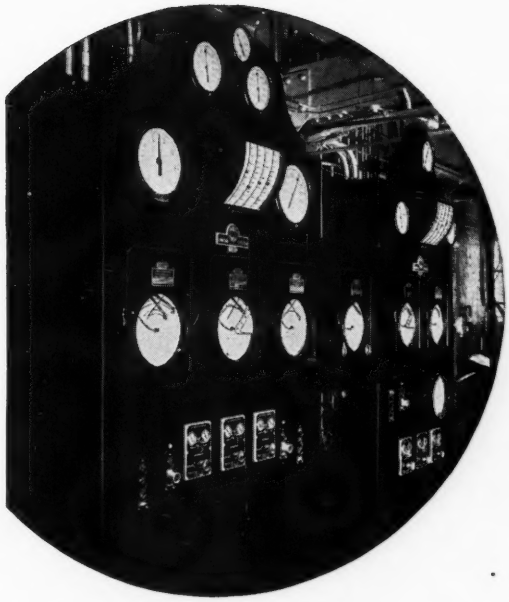
BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEA

★ Optimum performance may be secured on all these counts by applying engineered instrumentation in the form of Bailey Boiler Meters and Control.

Bailey Boiler Meters and Control are specified and applied to the individual requirements of each plant. Bailey engineering service starts with the selection of equipment and continues through the design, construction, calibration, installation, and final adjustment on the job.

Engineering work in the user's plant is done by Bailey Field Engineers, who have been thoroughly trained in combustion and automatic control practice. These engineers are stationed in over thirty industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey Engineer in your community has a background of combustion engineering "know-how" which has been accumulated through years of service. He has at his command the results of thousands of tests on boiler installations covering a wide range of fuels, furnaces, and fuel burning equipment. He has more to offer than meters and controllers. He is primarily interested in helping you to secure optimum operating conditions in your plant. G-24



Installation of Bailey Boiler Meters and Boiler Control in an Eastern paper mill. This equipment automatically functions to maintain daily boiler performance at the same high standards obtained during boiler tests.

BAILEY METER COMPANY
1040 IVANHOE ROAD, CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

The Complete Combustion Control System

HEA CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

QUALITY *Controlled* —for TIGHT VALVES

GARLOCK 117—furnished either braided or twisted in all sizes from 1/16" to 3/4".

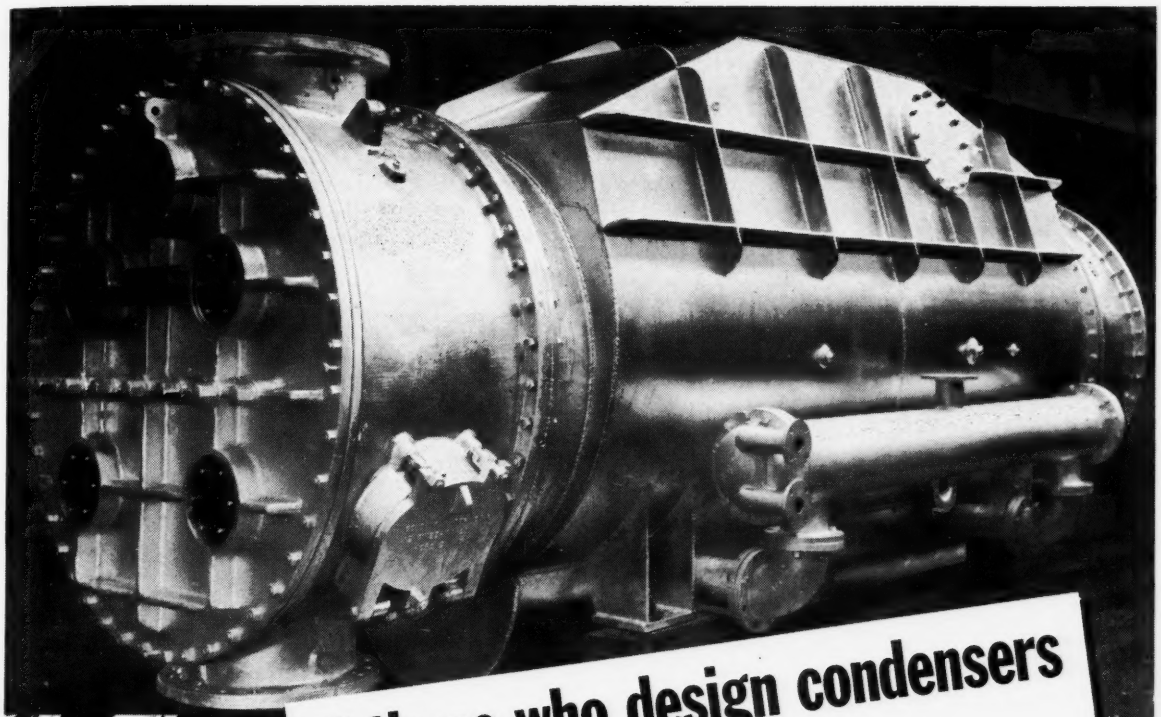
Garlock 117 Valve Stem Packing, like other Garlock products, is manufactured completely in the Garlock factory and is *quality controlled* from raw material to finished product. Each ingredient, each process, each operation is checked to conform with established Garlock standards.

This method of manufacture assures our customers of products that are uniform in quality day in and day out, year after year.

GARLOCK 117 is made from long fibre asbestos yarn, thoroughly lubricated with a special heat-resisting compound. Gives long, dependable service on globe and angle valves operating against high pressure steam, hot or cold water, or oil.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada, Limited, Montreal, Que.

GARLOCK



If those who design condensers also had to service them . . . . .

If the men who design condensers also had to service them, many of the troubles of operating engineers would vanish. Conseco condensers are designed and built by an organization with broad practical experience in servicing, repairing and rebuilding thousands of condensers of all types and makes. Every detail in a Conseco condenser is designed to profit from good and bad features uncovered by years of servicing condensers. This has resulted in the production of simple, efficient units, low in original cost and inexpensive to maintain. The unit shown above is a Conseco two-pass condenser with external air cooler. Deep water boxes and quick-opening manhole covers facilitate cleaning.

Conseco engineers will be glad to serve you. If you want fast action, write, phone or wire.

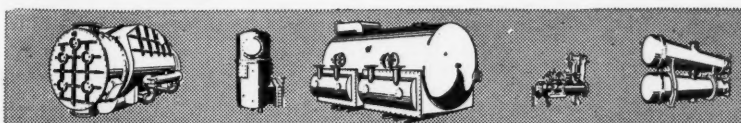
CONSECO

SERVICE

A highly skilled, specially equipped service organization, ready for immediate action anywhere on the continent, backed by engineering and manufacturing facilities producing over 3,000,000 sq. ft. of heat exchangers annually.

CONDENSER SERVICE & ENGINEERING CO., INC.

71 RIVER ST., HOBOKEN, N. J. **Phone HOboken 3-4425** **After 6 P.M. or Sundays - HOboken 3-4428**



CONDENSERS • LOW PRESSURE EVAPORATORS • AIR EJECTORS • HEAT EXCHANGERS • PUMPS

TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
BEVEL GEAR UNIVERSAL JOINTS
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS

Put *Your Water Problem* up to Betz

It has often been said this is an age of specialization. As a matter of standard practice modern industrial management seeks the assistance and guidance of engineering specialists for the solution of operating and production problems. In the field of water conditioning, in particular, supervision by skilled specialists is a *"must."* The organization of W. H. & L. D. BETZ with a nation-wide staff of engineers and chemists is prepared to assist you in those problems involving boiler feed water . . . cooling water . . . process water . . . industrial waste disposal . . . and sewage disposal.

Your water problem can be solved by Betz. Here, in one organization you will find all of the facilities and services so necessary to insure you against the hazards of incorrectly conditioned water.

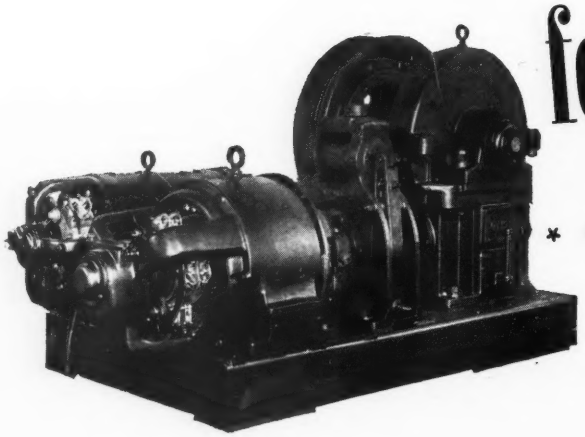
Write today *for our free booklet giving complete details on the formation and methods for prevention of boiler scale. You will be interested in such specific topics as the mechanics of scale formation — effect of boiler scale—internal chemical treatment—control of chemical treatment—and feeding of internal correctives. Ask for Bulletin 98 B. W. H. & L. D. BETZ, Gillingham & Worth Sts., Philadelphia 24, Penna.*

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING
INDUSTRIAL WASTE DISPOSAL

Cover photograph from the *Betz Indicator*, a monthly publication devoted to the chemistry and practical applications of water conditioning. The *Betz Indicator* will be mailed without charge at your request.

Otis Maintenance for Otis Elevators



Otis Maintenance is a service under which the owners of Otis elevators place the entire care of their elevator equipment in the hands of the manufacturer.

This service by Otis for Otis elevators cannot be duplicated at any price. There are three reasons for this:

Men — a field and headquarters organization combining the knowledge and experience of trained elevator men with that of those who designed and built the equipment.

Materials — including genuine Otis parts, special Otis tools, and over a million dollars worth of emergency replacement equipment.

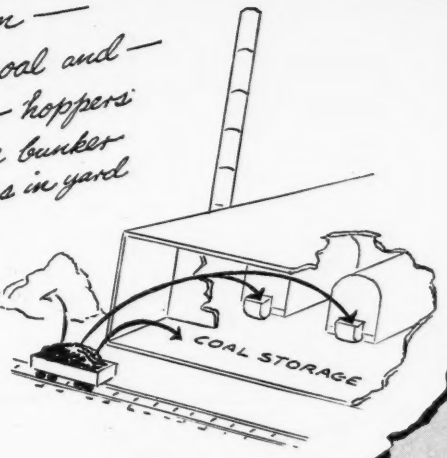
Maintenance Methods — the result of periodic inspections, lubrication, adjustment and replacement of parts, supported by scientific study and research to make elevators run better and last longer . . . a clinic that, *in one day*, gains experience that would take the average owner over fifty years to accumulate.

Under Otis Maintenance the world's greatest store of elevator knowledge and experience is combined with the facilities of the manufacturer of more than half of the world's elevator equipment.

You can obtain this service for your elevators at a flat monthly rate. Complete details are available through local Otis Elevator Company offices.

Otis ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES

The Problem —
to unload coal and —
1 — fill stoker hoppers
2 — fill storage bunker
3 — store surplus in yard
4 — reclaim to
live storage

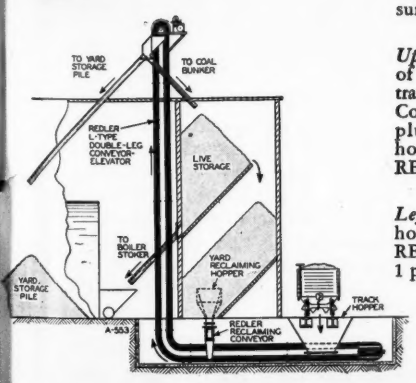


REDLER Conveyors *Solve* 4 in 1 PROBLEM

Upper Left: Head end of REDLER Conveyor-Elevator and 2-way spout which delivers coal to live storage bunker or surplus yard storage.

Upper Right: General view of power plant, showing track hopper, REDLER Conveyor-Elevator, surplus yard storage and hopper to reclaiming REDLER Conveyor.

Left: Diagram showing how the two versatile REDLERS solve the 4 in 1 problem.



Two versatile units — one REDLER Conveyor-Elevator and one REDLER Conveyor — solve the coal handling problem in this small power plant, where four separate coal handling operations were desired.

In action, this practical S-A REDLER System unloads coal direct from cars and distributes: (1) to inside gravity storage above stoker hoppers, (2) to inside surplus storage, (3) to outside yard storage, and (4) reclaims from inside and yard storage to live storage bunker as needed.

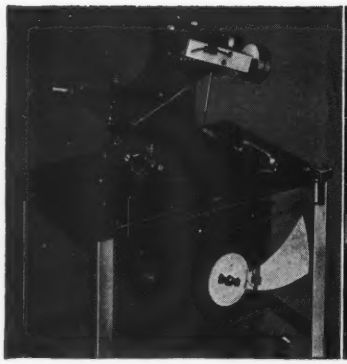
Catalog No. 140 gives engineering details and shows typical installations of REDLER Conveyor-Elevators — the original and most effective mass-movement, sealed casing conveyors.

STEPHEN S-A ADAMSON MFG. CO.

815 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

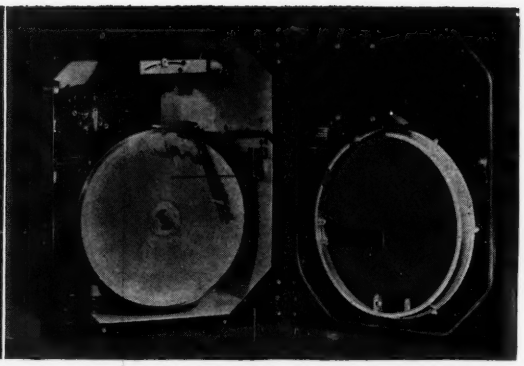
Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT



Meter assembled as one unit on rack ready for calibration.

Meter assembly can be easily removed from the case.



Meter with door open showing accessibility of all adjustments and working parts.

Republic Boiler Meter

ON ONE CHART

STEAM FLOW
AIR FLOW
TEMPERATURE
OR PRESSURE

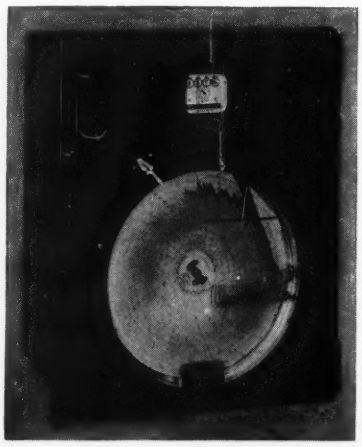
★ The new Republic Boiler Meter provides, in one instrument and on one chart, all the essential information concerning boiler performance regardless of the size or type of boiler, kind of fuel or method of firing. ●

The meter indicates, records, and integrates steam flow from the boiler and records rate of air flow for combustion. When the correct amount of air for maximum combustion efficiency is being supplied the air flow pen will record coincident with the steam flow pen, regardless of the load being carried by the boiler.

A third pen recording flue gas temperature (or steam pressure) can be added thereby providing the operator with complete information, on one 12-inch chart, relative to the performance of the boiler at any given time.

The Republic Boiler Meter consists of a standard Republic electric steam flow recorder and integrator and an oil sealed, bell type air flow element.

The air flow element consists of an oil sealed bell in a sealed chamber. The motion of the bell is transmitted through a diaphragm seal. This arrangement permits the use of a single bell—the high pressure being applied to the top of the bell and the low pressure under the bell. This arrangement also excludes air and dirt from the oil. The motion of the bell is transmitted to a cam system which extracts the square root, or when adjusted for a particular installation, compensates for chimney action and variable excess air requirements. The air flow pen is attached to the cam system with an adjustable linkage which permits changing the steam flow air flow ratio as conditions may require.



The entire operating mechanism is housed in a rugged steel case and can be easily removed as a single unit by merely loosening two anchor bolts and disconnecting the two air connections. The meter may be either wall mounted or flush mounted on a steel panel. *Write for Bulletin No. 420.*

REPUBLIC FLOW METERS CO.

2224 DIVERSEY PKWY. CHICAGO 47, ILLINOIS

What 0.04% Phosphorus Does To Your Dezincification Problem

Plain Admiralty Metal has almost all the properties for successful condenser and heat exchanger tube service that are needed to meet many power plant and oil refinery applications . . . but it has one weakness — fair to poor resistance to dezincification.

Under certain conditions, its brass content is gradually replaced by a spongy, porous copper deposit, locally (plug type) or uniformly over the tube (layer type).

To overcome this problem . . . and still retain the high corrosion resistance of plain Admiralty . . . Scovill *Service in Metals* developed Phosphorized Admiralty*. This is the alloy that Scovill engineers are recommending for many types of power plant and oil refinery service where dezincification of plain Admiralty has been observed or anticipated.

Many Times Greater Life

By inhibiting dezincification, Phosphorized Admiralty offers much longer service life. This improvement is brought about by a very slight change in the alloy composition — the addition of approximately 0.04% phosphorus. There is no appreciable difference in the structure or mechanical properties between regular and Phosphorized Admiralty as shown by the photomicrographs and graph at the right. There is no impairment of the metallurgical, physical and otherwise excellent corrosion-resistant properties.

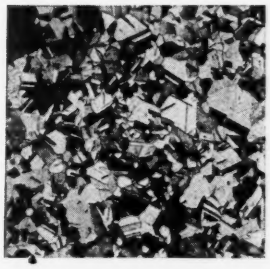
Experience of Scovill customers has shown that in cases where dezincification has been troublesome, a change to Phosphorized Admiralty extends service life.

*"Phosphorized Admiralty Tubes" for condenser and heat exchanger service are covered by patent 2,224,095 and can be legally supplied only by Scovill Manufacturing Company, the owner of this patent.

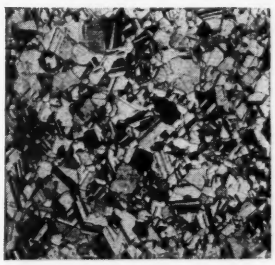
Other Scovill Services

Service in Metals, which includes the development of new alloys to meet changing service conditions and also individual study of specific customers' problems, is one of three Scovill services, well-known throughout Industry. *Service in Men* provides specialized advice on tube problems, installation aids and "follow-up" services. *Service in Manuals* offers valuable literature on condenser and heat exchanger tubes. For a copy of our Condenser Tube Booklet, address Scovill Manufacturing Company, 17 Mill Street, Waterbury 91, Conn.

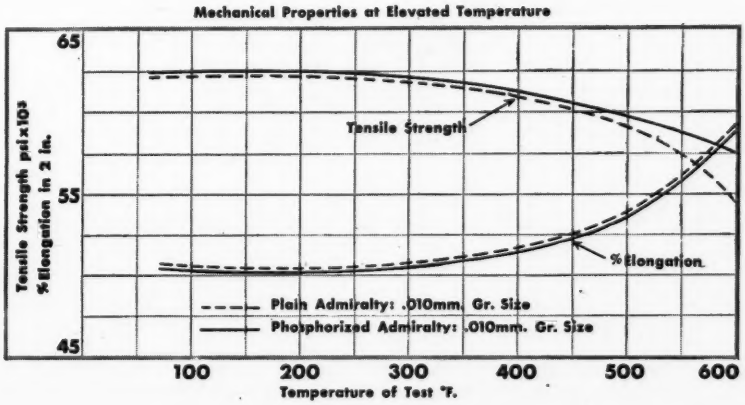
Top: Plain Admiralty.
Bottom: Phosphorized Admiralty.



75 x magnification.
Average grain size .035 min.



Mechanical Properties at Elevated Temperature



Plain Admiralty		Phosphorized Admiralty	
Copper	70.0 — 73.0	Copper	70.0 — 73.0
Tin	0.90 — 1.20	Tin	0.90 — 1.20
Lead	0.075 max.	Lead	0.075 max.
Iron	0.06	Iron	0.06
Phosphorus		Phosphorus	0.10 max.
Zinc	remainder	Zinc	remainder

Scovill
MANUFACTURING COMPANY
WATERBURY 91, CONN.

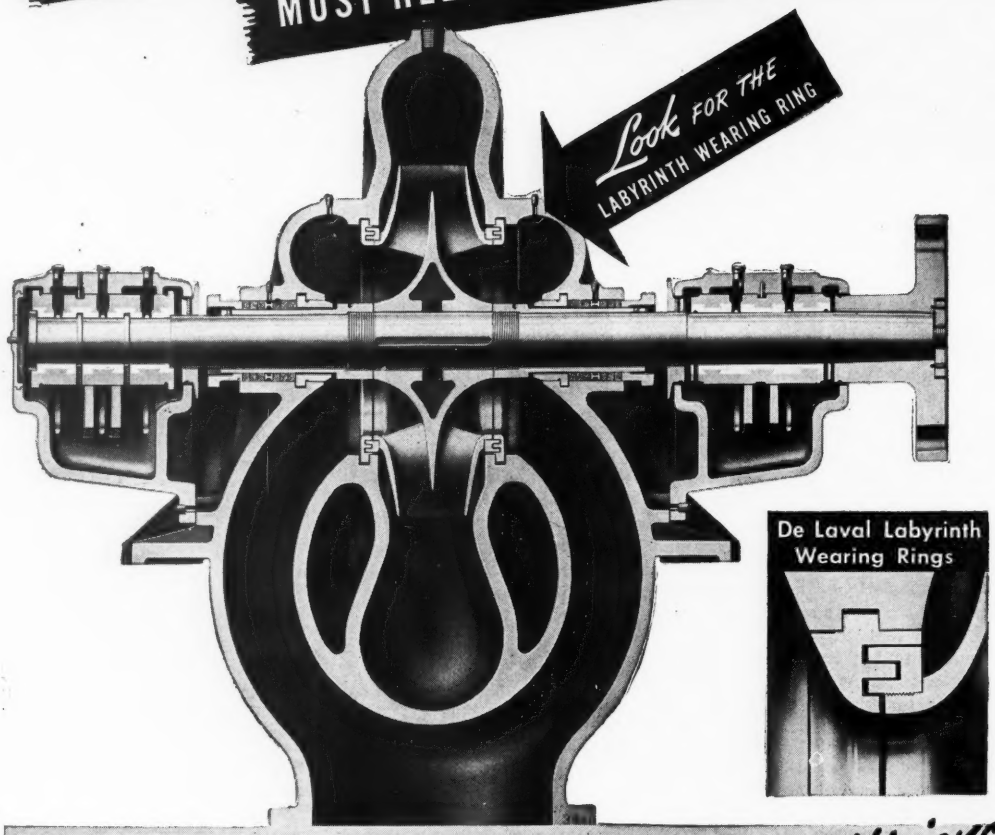
SCOVILL CONDENSER TUBES

ONE PRODUCT . . . THREE SERVICES

Service in Manuals . . . Service in Metals . . . Service in Men

THE PUMP YOU BUY *TODAY*

MUST HELP MEET COMPETITION *TOMORROW*



DE LAVAL LABYRINTH RINGS *keep efficiency UP cost DOWN*

De Laval Labyrinth Wearing Rings minimize leakage from discharge back to suction. The sealing action of these rings is accomplished by the use of large clearance, tortuous labyrinth passages and does not depend upon close mechanical clearances, such as required for plain flat rings. Because of the larger clearances and reduced flow, the effectiveness of the De Laval labyrinth ring is but little diminished by wear, resulting in sustained efficiency for long periods. When selecting pumps for lowest ultimate cost, look for the De Laval Labyrinth Wearing Ring.

3237

TURBINES • HELICAL GEARS
WORM GEAR SPEED REDUCERS
CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

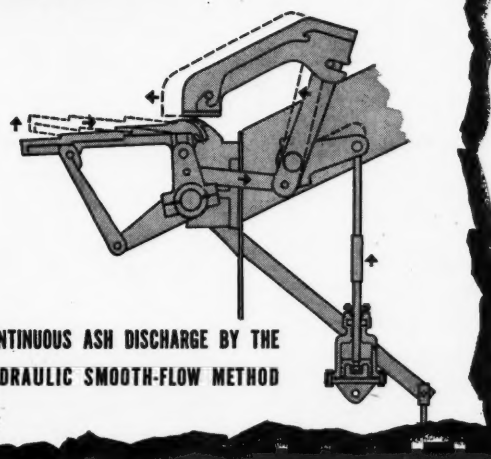
DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

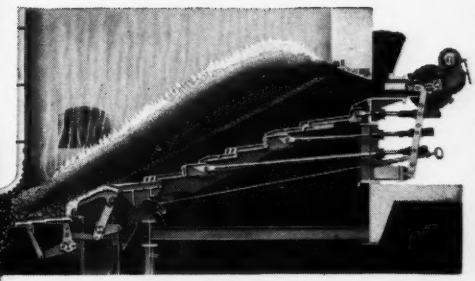
SALES OFFICES ATLANTA • BOSTON • CHARLOTTE • CHICAGO • CLEVELAND • DENVER • DETROIT • HELENA • HONOLULU • HOUSTON • KANSAS CITY • LOS ANGELES • MANILA • MONTREAL • NEW HAVEN • NEW ORLEANS • NEW YORK • PHILADELPHIA • PITTSBURGH • ROCHESTER • ST PAUL • SALT LAKE CITY • SAN FRANCISCO • SEATTLE • TORONTO • TULSA • VANCOUVER • WASHINGTON, D C • WINNIPEG
And Cities in Central and South America

What a Whale of a Difference!

. . . BUT THE BASIC PRINCIPLE IS STILL THE SAME



CONTINUOUS ASH DISCHARGE BY THE HYDRAULIC SMOOTH-FLOW METHOD



IMPROVEMENTS Make the Difference in Æ Taylor Stokers, Too!

CONSTANT IMPROVEMENTS have kept the flexible, versatile Æ Taylor Stoker two jumps ahead of fluctuating fuel prices, shifts in coal availability and strides forward in power plant economy. Just one of the advanced engineering features that adds to its 40-year success story, is the smooth-flow hydraulic drive which brings new efficiency to continuous ash discharge.

The smooth action of powerful hydraulic cylinders has been harnessed to provide simple, direct operation of the overfeed sections of the stoker—moving ash all the way to the tip of the ash discharge plate, at a predetermined, uniform rate. Independence from the main stoker drive eliminates complex mechanisms and the need for frequent adjustment. You get positive ash discharge *continuously* as required by fluctuating steam requirements and the variable ash content of coals.

Find out more about this and other *improved* features of the Æ Taylor Stoker—how they can be adapted to consistently produce more steam at top efficiency in *your* plant. Write for Catalog R-A or ask for specific engineering assistance.

Other Æ Products: Æ-Perfect Spread Stoker, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power

Æ

TAYLOR STOKER

AIR-COOLED & WATER-COOLED

The Only Underfeed Stoker with *all* these Features IN COMBINATION!

1. Continuous Self-Sealing Ash Disposal
2. Movable Ash Discharge Plates
3. Smooth-Flow Hydraulic Drive on Rear End
4. Independent Pusher Controls within ⅛ inch
5. Unique Sure-Feed Coal Agitators
6. Silent-Shift Spur Gear Planetary Power Transmission

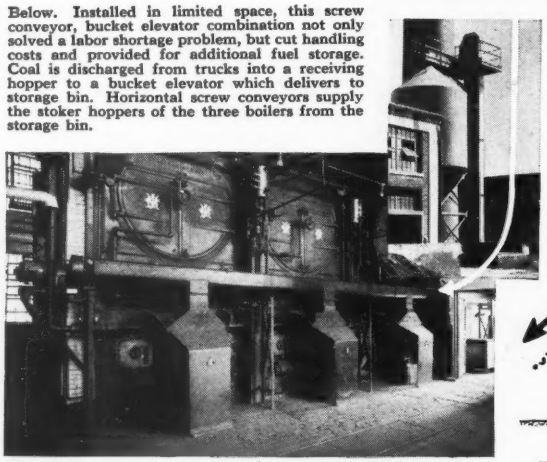
AMERICAN ENGINEERING COMPANY

2408 ARAMINGO AVE., PHILADELPHIA 25, PENNSYLVANIA

How Conveyor-Mechanization *Cut Steam Costs*

for These Small and Moderate Size Plants

Below. Installed in limited space, this screw conveyor, bucket elevator combination not only solved a labor shortage problem, but cut handling costs and provided for additional fuel storage. Coal is discharged from trucks into a receiving hopper to a bucket elevator which delivers to storage bin. Horizontal screw conveyors supply the stoker hoppers of the three boilers from the storage bin.



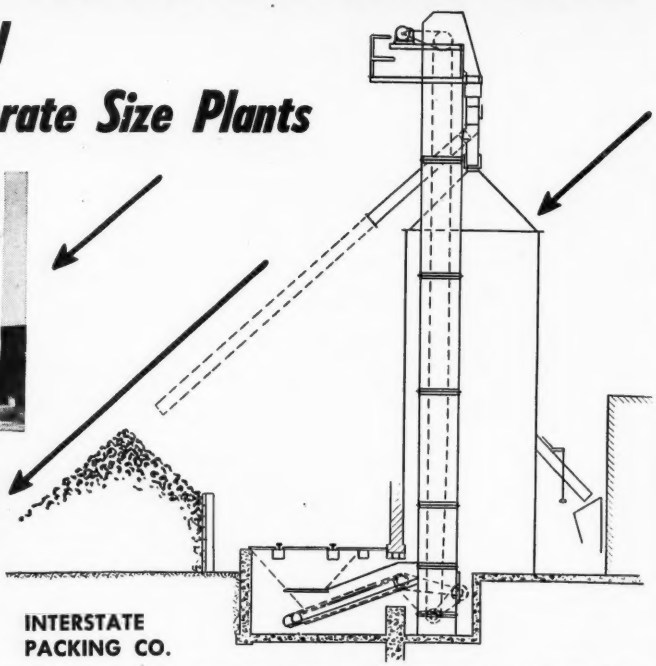
Boiler room expansion with covered coal storage was accomplished at this plant without enlarging or raising roof of building or bunkers. Link-Belt elevator takes coal, delivered by truck, to silo with 20 ton live and 80 ton dead storage. Coal is spouted to boilers from this silo.

* * *

Whether your plant is large or small, and no matter what your conditions might be, there is suitable Link-Belt equipment to meet every requirement. Before you do anything else about it, talk over your problem with an experienced Link-Belt engineer. Send for Book No. 1510, "Solving the Problem of Coal and Ashes Handling."

LINK-BELT COMPANY

Chicago 8, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.



INTERSTATE PACKING CO.

This drawing shows a Link-Belt coal handling installation at this Wisconsin plant. It consists of track hopper, apron feeder, bucket elevator and storage bin. Coal is chuted direct from the bin to stoker hoppers with a detachable chute to outside storage. A simple and completely mechanized system that cut costs and increased efficiency.

This ingenious, low-cost method of handling coal to the hoppers of two Link-Belt stokers from floor-level storage, utilizes an inclined Link-Belt screw conveyor with hinged discharge spout that permits coal delivery to either hopper as desired. This semi-automatic combination of screw conveyor and stokers is paying big dividends by cutting coal handling costs.

Vertical run of Link-Belt Bulk-Flo conveyor-elevator which delivers coal from storage pit outside boiler room wall to weigh larry. Slide gates in the wall lower the coal to the horizontal section of the Bulk-Flo. The vertical section delivers to a suspended weigh larry, equipped with chute, to hand-operated undercut gate, which regulates discharge to stoker hoppers. Bulk-Flo combines in a single unit, the functions of an elevator, a conveyor, and feeder with extreme flexibility of layout for coal and other flowable materials.

10,193

LINK-BELT THE SYMBOL OF QUALITY LINK-BELT COMPANY

COAL AND ASHES HANDLING EQUIPMENT

THE KEY TO SUCCESSFUL TEMPERATURE CONTROL

SARCO TR-21

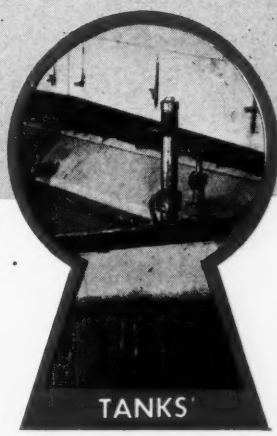
Thousands of dollars are involved in the difference between success and failure—of temperature control.

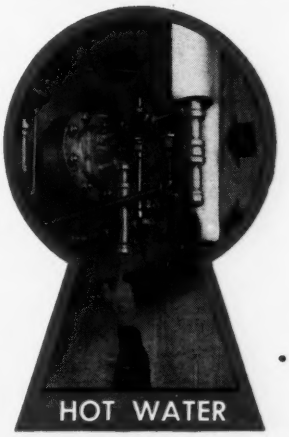
In process work—a degree or two difference means rejects. Failure means lost production.

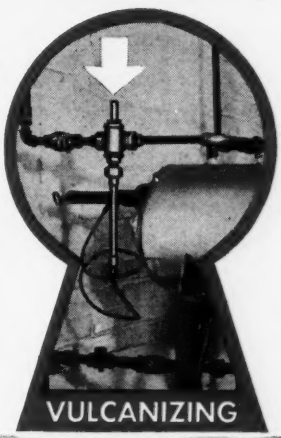
In hot water service—it's fuel economy and reliability that count most.

The Sarco TR-21 is self operated with a thermostatic element of the liquid expansion type. No stuffing boxes to stick or leak. All valves are equipped with packless seals. Temperature ranges: 0 to 400 degrees F.

This regulator has been outstandingly successful for all kinds of process, hot water, and liquid temperature controls since 1912. Its companion, the KR-14, is ideal for control of air and gases. Ask for Bulletin No. 600.







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That's the way the good word about Yarway Indicators is spreading. Plant after plant is finding that here at last is an instrument that gives safe, positive check on overhead water gages right down at convenient eye level . . . on a brilliant scale that is visible even in total darkness.

Yarway Remote Liquid Level Indicators are *accurate* because they are operated by the boiler water itself . . . by the pressure differential between a constant head of water and the varying head in the boiler drum. Indicating mechanism is perfectly balanced on jewelled bearings, and is never under pressure. Therefore, no stuffing boxes are required. Action is instant, constant, frictionless. Made for panel mounting or wall mounting, and suitable for all pressures up to 1500 psi.

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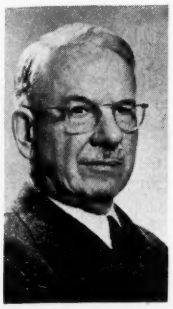
YARWAY REMOTE LIQUID LEVEL INDICATOR

WHAT LEADERS SAY

Rules for Economic Stability

By A. W. ROBERTSON



BY following a course that caused complete financial breakdown in the sound economic life of other nations, we have produced a financial bomb which threatens to blow our economy to destruction. The world is suffering from the economic dislocation of war and the United States didn't pay the full economic price for the war while it was being fought, so we must pay for it after it has been won.

No doubt millions of our people will rebel against doing what the payment will require. Economic, social and political convulsions as powerful as an earthquake are undoubtedly future possibilities.

Tracing the growth of the nation's industrial economy, we observe that as long as the ratio of production to the expenditure of labor was on the favorable side and we were making more than we were spending, all was well, because a national economy resembles a top in that the faster it spins the more stable it is.

But during the depression the economy top began to run down and show a dangerous lack of balance and, since our affairs had outgrown the book of rules and since there was no duplicate of America in the world, weaknesses and faults were misunderstood and misinterpreted.

Tampering with the money standards was among the distinctly harmful remedies. We followed this by increasing the quantity of money out of all proportion to things and services, following a course that had caused a complete breakdown in the sound economic life of other nations.

This abnormal condition was made dangerously explosive by financing a large part of the colossal expenditures of the war through the banking system. We printed currency and exchanged bonds for new bank deposits and in these and other ways pushed our supply of funds up to two and one-half times the size of the money supply of 1940. This supply is now the tremendous sum of $163,000,000,000. It was only $67,000,000,000 five years ago. We have produced a financial bomb which threatens to blow our economy to destruction.

But economy is a part of living and as long as we are alive the show must go on no matter how poor the performance. We can't stop it as we would a machine and examine it and determine what is wrong before running it again.

I think the root of our present troubles, in addition to the threat of inflation, is our dependence upon others without a clear comprehension of what this implies. Striking workmen in crowds exercise rights which no individual has. In other words, 10 or 10,000 may do something as their right which one man could not do without committing a crime. This is now accepted in all society, and we commonly use the phrase, "the right to strike." Obviously, it is a vague term and needs definition. Society cannot safely be at the mercy of groups of men or organizations. Freedom has taken on a new definition.

The thought of a few men having control of the atomic bomb jogs us into a realization that their power should be curbed, but what difference is there between having your business blown to atoms and having your business ruined by the same group of men preventing you from using your property? In both cases you suffer equal loss.

As far as I am concerned, the man who takes from me by force what is not rightly his is a robber even if a vote is taken on it or if his number is legion. Tyranny may be exercised by the many as well as by one.

We need to awaken to the fact that there is no end to the business organizations or groups of people who can, by the simple act of stopping work and preventing others from doing their jobs, hold up the rest of society and extract any penalty they wish. We need to acknowledge duties as well as rights.

Unless there is public acceptance of duties as well as rights, the national economy will slow down by right checkmating right until we are literally doing more and more and producing less and less and the unbalance will become so chronic that we may ultimately run down entirely.

To keep going, and go we must, the modern specialized workman must know his rights and duties in terms of modern social needs. It is equally imperative that the employer know his rights and duties in terms of social needs.

Due to the confusion of rights without duties, the time of citizens is taken up in disputes which cannot be settled because of lack of accepted standards. Alleged rights are insisted upon. Duties are unknown. Liberty is threatened.

Is it not time that we, the people, insist on everyone and every organization standing in line and waiting its turn? A little unrest and confusion may be overlooked in our swiftly changing world, but in the end order is of necessity the basic element in our economic stability.

Through depression, booms and the critical years of World War II, Andrew Wells Robertson has guided the Westinghouse Electric Corp. with this philosophy: "We consider Westinghouse to be an organization which holds the same duty toward our country as an individual, and we are trying to act as an individual should act under similar circumstances." He was born in the little town of Panama, N. Y., in 1880. When he finished school he taught for two years in the schoolhouse where he had studied. Determined upon a career at law, he entered Allegheny College at Meadville, Pa., when he was twenty-two years old. Upon graduation he served as principal of the high school at Charleroix, Pa., for a year; then went to Pittsburgh to enter law school. He was admitted to the bar in 1910. In 1913 came an opportunity to take part in the legal work of the Pittsburgh Railways Co., which was associated, through the Philadelphia Co. with all the utilities companies of Pittsburgh. By 1918 Mr. Robertson had become general attorney of the Philadelphia Co. In 1923, he became vice president and, three years later, president. In 1927, The Board of Directors of what was then the Westinghouse Electric & Manufacturing Co., chose him for the position of chairman of the board, which he has held ever since. The above comments are from a recent address by Mr. Robertson before the Economic Club of New York.

TOPPING AT HELL GATE

Part II. In the November issue, R. T. Roberts described the boiler installation of the topping program now in progress at Hell Gate Station of the Consolidated Edison Company of New York. This, it will be recalled involved the installation of two 900,000 lb per hour, 950 psi, 950 F steam generating units. Now, in this article, Mr. Knecht takes up the design and installation of the turbogenerating equipment. The two boilers described by Mr. Roberts and the 65,000-kw generating unit covered in this article constitute the first half of the topping program. Ultimately, there will be four boilers and two topping turbines. Under the part of the project now being completed, there will be two boilers and one generating unit. The exhaust steam from this 65,000-kw topping unit will generate 150,000 kw.

By H. Knecht **Division Engineer, Consolidated Edison Co. of New York, Inc.**

IN PLANNING the initial topping installation for Hell Gate Station the physical limitations of the site and the limitations in capacity set by the manufacturers had to be considered. The removal of only two rows of low pressure boilers limited the new boiler plant to two boilers of approximately 1,000,000 lb maximum capacity each. To date the largest 3600 rpm generators which have been made are 65,000 kw units. This size matched the boiler capacity if operated at 900 psi 950 F.

Studies were made however for various steam conditions. The maximum safe temperature for carbon molybdenum steel established the desirable initial steam temperature limit as 950 F. It was necessary to maintain the exhaust temperature at approximately 700 F for efficient and economical use of the existing low pressure units.

The following tabulation, made for 70 per cent annual capacity factor illustrates the relative costs and efficiencies of various steam cycles assumed, for one boiler only.

Case 3 required reheat because of the high exhaust temperature necessary for the L.P. units. This accounts for about ⅓ of the increased cost of Case 3, the remaining increase being due to the higher operating pressure. As the operating savings for Case 3 do not justify the added investment costs, this design was discarded. Because of a lack of operating experience with 1000 F anywhere in the country, Case 1 was also discarded as it had no real advantage over Case 2

	Case 1	Case 2	Case 3
Pressure at throttle—psig	1000	900	1800
Temperature at throttle—F	1000	950	950
Reheat—F	None	None	925
H.P. Boiler Evaporation—M lb/hr	895	985	845
H.P. Kw	36,300	35,700	44,500
L.P. Kw	70,200	76,100	66,300
Total Gross Kw	106,500	111,800	110,800
Total Net Kw	103,500	108,800	107,800
L.P. Steam Rate lb/hr	10.2	10.35	10.2
Net Operating Heat Rate Btu/Kwh	11,600	11,860	11,000
Estimated Annual Savings	Base	0	$95,000
Estimated Difference in Cost	Base	+47,000	+557,000

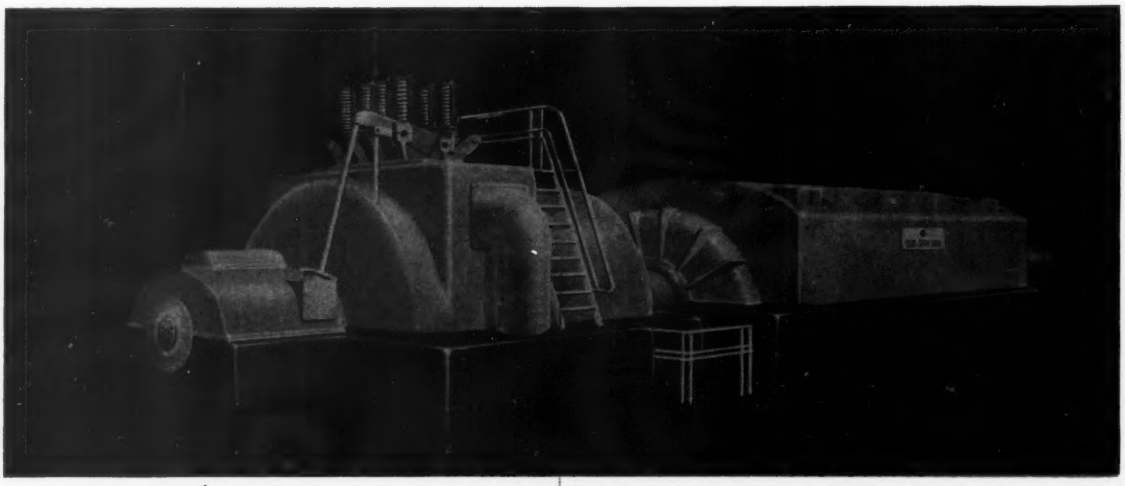


Fig. 1. Designer's rendering of the new 65,000-kw topping unit at Hell Gate

to justify experimenting with the higher temperature.

Turbine Generator

The turbine-generator unit manufactured by the General Electric Company is rated at 65,000 kw at 0.8 power factor, 13,800 v, 60 cycle, 3 phase and operates at 3600 rpm. The design conditions are 900 psi, 950 F at the throttle and 280 psi, 672 F at the exhaust.

As indicated in the cross-section Fig. 2 this turbine is a single flow, double shell impulse type having 10 stages. Fourteen control valves are provided, seven in the top half and seven in the lower half. Eight valves admit steam to different sections of the first stage nozzles, four admit steam to the first stage shell and two admit steam to the third stage shell.

Two stop valves are provided, each taking steam from a common header, so designed as to properly mix and streamline the flow from the two boiler leads. Each stop valve supplies both the upper and lower steam chests.

The control system is a combination of hydraulic and mechanical devices using high pressure oil as the actuating medium.

The governor driven from the turbine shaft operates through a system of hydraulic and mechanical devices to position the admission valves.

A pressure regulator comprising a back pressure and a differential pressure element is connected into the governor system and is so arranged that either the back pressure, the differential pressure across the last stage or the speed governor may act to close the admission valves or limit their opening. A manually operated load limit device is provided to limit the position of the admission valves. Such limitation of load may be desirable if either the turbine or boiler capacity is below normal, in which case the generator should not be free to pick up its share of load in the event of a sudden decrease in system frequency.

No safety valves have been provided on the turbine casing but the following protective features have been added:

1. Exhaust casing designed to withstand full boiler pressure.
2. A sentinel valve on the exhaust casing set at 300 psi.
3. Exhaust pressure trip set to trip turbine throttle valves if back pressure reaches 325 psi.
4. An interlock whereby the turbine inlet throttle or stop valves cannot be opened if the exhaust gate valve is less than 15 per cent open. Closure of the exhaust gate valves will trip the turbine.
5. The 30 in. exhaust gate valve is motor operated in the opening direction only and can be closed only by hand.

Oil System

Instead of the conventional design in which the main oil pumps are driven from the main turbine generator shaft through gearing, oil for control and lubrication on this machine is provided by two separate motor driven vertical twin gear type oil pumps. Each pump is capable of supplying the entire oil requirements of the unit. A vertical steam driven twin gear type oil pump is provided to supply oil in case of failure of the main oil pumps. This pump is controlled by either of two governors, one to start pump on failure of hydraulic governor oil, and the other on failure of bearing oil. (See Fig. 3.)

The turning gear oil pump in addition to supplying lubricating oil when operating on the turning gear, is arranged to start up automatically and provide oil for the main bearings in case the main and auxiliary oil pumps fail to operate.

Two main oil coolers are provided, so arranged that either one or both may be in service. One cooler is adequate for cooling purposes even with 75 degree cooling water.

To eliminate oil and water vapor around the main oil reservoir, a motor driven vapor extractor has been provided to exhaust these vapors and maintain a slightly sub-atmospheric pressure in the reservoir. The vapors are discharged to the roof.

Turbine Gland Sealing System

This turbine is provided with water sealed glands for normal operation. When this machine is at standstill or at low speed, steam jet exhausters connected to these glands prevent leakage of steam into the turbine room. These exhausters discharge to the outside atmosphere. When up to speed the gland runners establish proper seal.

Saturated steam at 600 psi will be used for washing soluble deposits off the turbine blading.

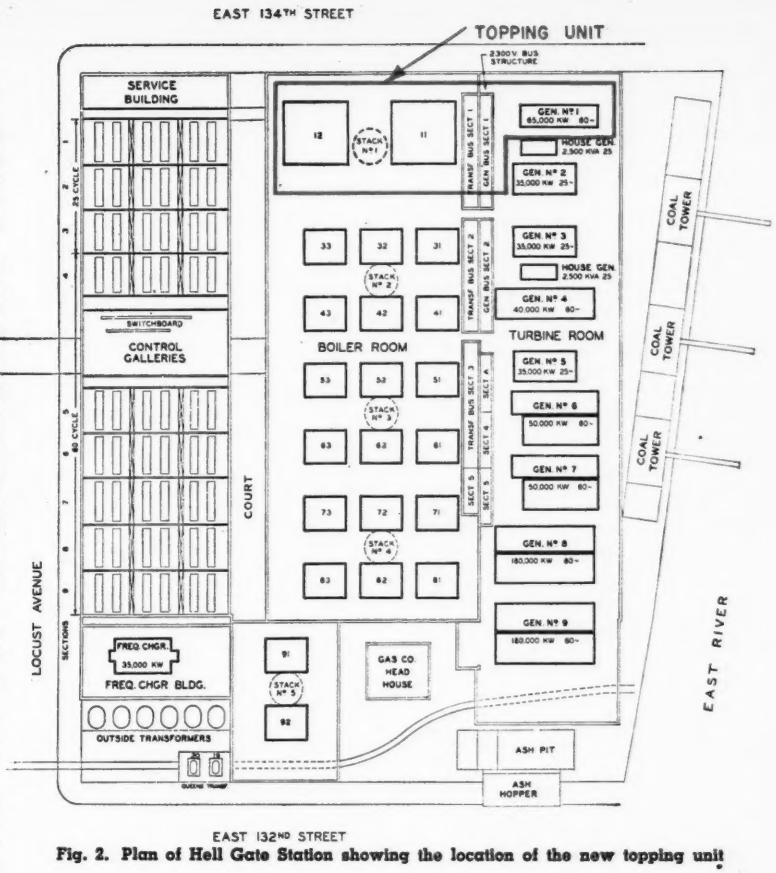


Fig. 2. Plan of Hell Gate Station showing the location of the new topping unit

Foundation Cooling

Because of the high exhaust temperature on this unit, and cases of "growing" foundation, the sole plate under No. 2 bearing is provided with stainless steel cooling coils. In addition a cooling coil has been provided on the front face of the girder under this beam, to protect this deep girder from direct radiation of the exhaust connections and thus minimize distortion. These cooling coils have been connected in parallel with the generator gas coolers.

Generator

The generator is of the hydrogen cooled type with integral fans and internal gas coolers. It is capable of delivering rated kva output at all terminal voltages from 13,110 to 14,490 v. With air cooling, the capacity of the generator is limited to 48,750 kva. Approximately 65,000 cfm of gas are required for ventilation. Normal rise in the armature at full rating is 60 deg C, in the field 85 deg C.

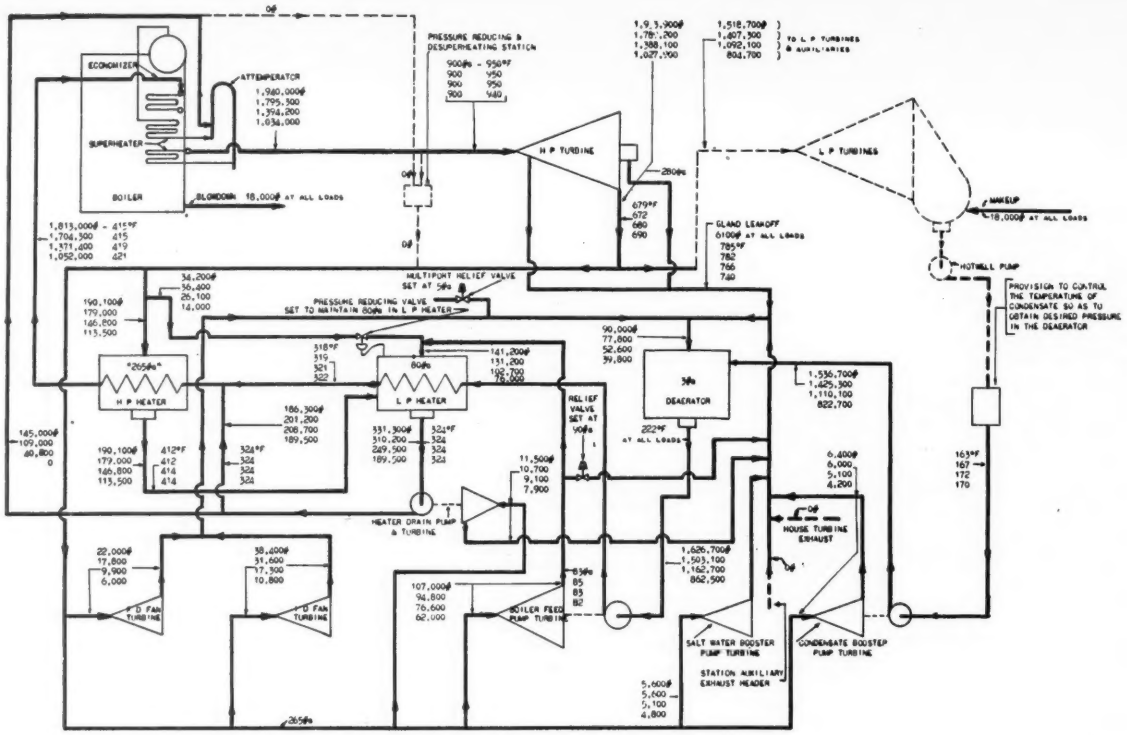

ECONOMIZER
ATTEMPERATOR
SUPERHEATER
BOILER
BLOWDOWN 18,000# AT ALL LOADS
PRESSURE REDUCING & DESUPERHEATING STATION
H P TURBINE
L P TURBINES
TO L P TURBINES & AUXILIARIES
GLAND LEAKOFF 6100# AT ALL LOADS
MAKEUP 18,000# AT ALL LOADS
HOTWELL PUMP
PROVISION TO CONTROL THE TEMPERATURE OF CONDENSATE SO AS TO OBTAIN DESIRED PRESSURE IN THE DEAERATOR
MULTIPORT RELIEF VALVE SET AT 50#
PRESSURE REDUCING VALVE SET TO MAINTAIN 80# IN L P HEATER
H P HEATER
L P HEATER
DEAERATOR
RELIEF VALVE SET AT 90#
HEATER DRAIN PUMP & TURBINE
HOUSE TURBINE EXHAUST
F D FAN TURBINE
I D FAN TURBINE
BOILER FEED PUMP TURBINE
SALT WATER BOOSTER PUMP TURBINE
CONDENSATE BOOSTER PUMP TURBINE
STATION AUXILIARY EXHAUST HEADER

Fig. 3. Flow Diagram of the topping installation

Excitation is provided by a gear driven exciter operating at 1772 rpm and a pilot exciter direct connected to the main exciter. The main exciter is rated at 220 kw, 250 v d-c, the pilot exciter at 4 kw, 250 v d-c. To protect against motoring, and consequent overheating of the turbine blades, a reverse current relay has been installed to ring an alarm at the high board. This relay closes when the generator starts to motor, ringing an alarm and lighting a lamp. The lamp is shut off only by opening the main breaker. However, operators' instructions call for taking the unit off the line when the load drops to 2000 kw.

A motor operated turning gear is provided to rotate the spindle at 3 rpm. A pressure switch is installed in the line supplying oil to the turning gears so that the turning gear motor can be started only if the oil is being supplied to the gears.

Hydrogen Seal Oil System

To prevent the leakage of hydrogen through the shaft seals, special oil sealed glands are provided. Oil is supplied to these glands by the gland seal oil pumps with a pressure, maintained by a differential pressure controller, of approximately 5 psi above the gas pressure.

Oil which has been in contact with hydrogen is drained to a defoaming tank where most of the entrained gas breaks out and is vented to the generator casing. The oil overflows to the hydrogen detraining compartment of the seal oil treating unit, where the gas has further opportunity to break out and return to the generator casing. Makeup to the seal oil system is obtained from the oil pump discharge through a float valve maintaining level in the air detraining compartment.

A float valve controls the flow of oil from the hydrogen detraining compartment to the vacuum compartment. Additional oil flows from the air detraining compartment through an orifice to join with the hydrogen contaminated oil and flow into the vacuum compartment through sprays. This combined flow is regulated by a level controller in the vacuum tank.

A vacuum pump is connected to the vacuum tank to maintain approximately 29-in. vacuum in this tank. The high vacuum degasifies the oil and removes any moisture present.

Treated oil is pumped by the main gland seal oil pump through a cooler to the glands. As only 20 to 30 gpm are required at the seals, about 100 gpm are recirculated through the vacuum tank to a relief valve, the pressure in the glands being automatically maintained by the differential pressure regulator. In case of a failure of the main seal oil pump, an emergency pump is automatically started by means of a pressure switch. If this second pump fails to cut in, oil for the seals is supplied from the main oil pump discharge through a pressure operated diaphragm valve.

Hydrogen Ventilating System

During normal operation the generator will be cooled by hydrogen circulated through the stator by the integral fans at a rate of 65,000 cfm. Approximately 1600 cu ft of hydrogen are enclosed within the generator casing. Although leakage is reduced to a minimum by the shaft sealing arrangement, it is expected that about 45 cu ft will be lost through entrainment in the gland seal oil and through the generator casing.

The hydrogen is kept dry by circulating a part of the gas continuously through an activated alumina dryer, utilizing the differential pressure across the shaft fan.

The purity of the hydrogen in the generator is indicated by a gas analyzer, which measures the thermal resistance of a continuous sample in comparison with a standard gas cell by means of a potentiometer and a Wheatstone bridge arrangement.

A water detector has been connected to the low point of the generator casing, to ring an alarm in case of leak in the water circuit of the hydrogen gas coolers.

Gas Cooling System

The heat picked up by the ventilating gas in the generator is dissipated indirectly by river water. The heat is transferred to fresh water circulating through the gas coolers and then transferred from the fresh water to salt water in two heat exchangers. This system prolongs the life of the

gas cooler tubes and prevents salt water from getting into generator in case of tube failure.

A hydrogen cooling water pump is employed to circulate fresh water. An open head tank floats on this system with an automatic city water make up supply. Emergency supply from the city water system is controlled by a motor operated gate valve, which opens wide when energized by a thermostat actuated by high gas temperature. This valve is arranged for manual throttling to suit requirements. (See Fig. 6)

Condensate and Boiler Feed System

Condensate for the high pressure system is taken off at points in the low pressure condensate system after having passed through the low pressure or high pressure bleed heaters (dependent on temperature requirements) of Units 5, 6, 7, 8 and 9. Connections have also been provided so that condensate from Units 3 and 4 may also be used when makeup is not being supplied to these units.

For normal operation the temperature of condensate to the booster pumps should be approximately 160 F. This temperature can be maintained by hand control of the quantity of condensate from either the high pressure or the low pressure heaters of the low pressure units. Thermometers are located in the branch headers from each unit and in the main booster pump suction headers. In addition a temperature indicator is located at the pumps.

Three (3) turbine driven condensate booster pumps are installed, one of which will normally be a spare. These pumps discharge the condensate directly into the deaerating heater, the level in which is held by regulators varying the throttle pressure and thus the speeds of the pump turbines.

The deaerator is a Cochrane direct-contact jet, tray type, rated at a capacity of 1,900,000 lb per hr of condensate measured at the discharge of the storage section. It is guaranteed to deliver the above capacity with an oxygen content in the effluent not in excess of 0.005cc per liter, regardless of the oxygen initially in solution in the water delivered to the heater. This guarantee is based on condensate at a temperature between 130 F and 180 F and the necessary steam at 18 psia and 376 F. (See Fig 9).

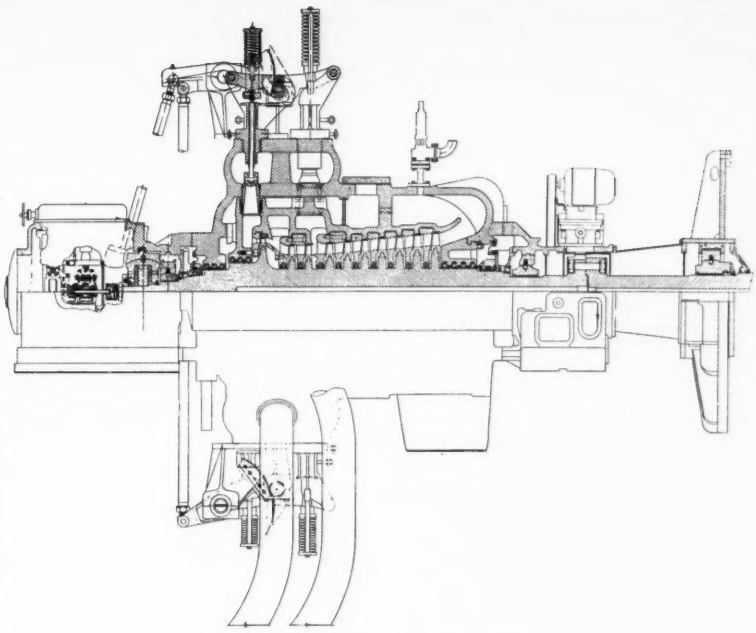


Fig. 4. Cross section of the turbine

Provision is made for the admission of 300,000 lb per hr of closed heater condensate in case of failure of the heater drain pumps.

The inlet water passes through 2 vent condensers set in parallel, thence to a water piping manifold and finally to the internal water distribution pipes. After leaving the distribution pipes the water is caught by a baffle and passes through a water seal to water distribution boxes above the trays.

Steam enters the deaerator midway between the 2 tray banks and passes through the tray section where deaeration takes place. The steam that flows around the tray section to the upper sections in which are located the water distribution pipes where heating and final deaeration occur. Vent steam then passes from this section to the vent condensers from which the non-condensible gases are vented with approximately 500 lb of steam per hour. Gate valves are provided to permit isolation of one vent condenser if desired with the deaerator in service.

Heater level is maintained with the condensate booster pumps by controlling the differential head established by the level of liquid in the heater.

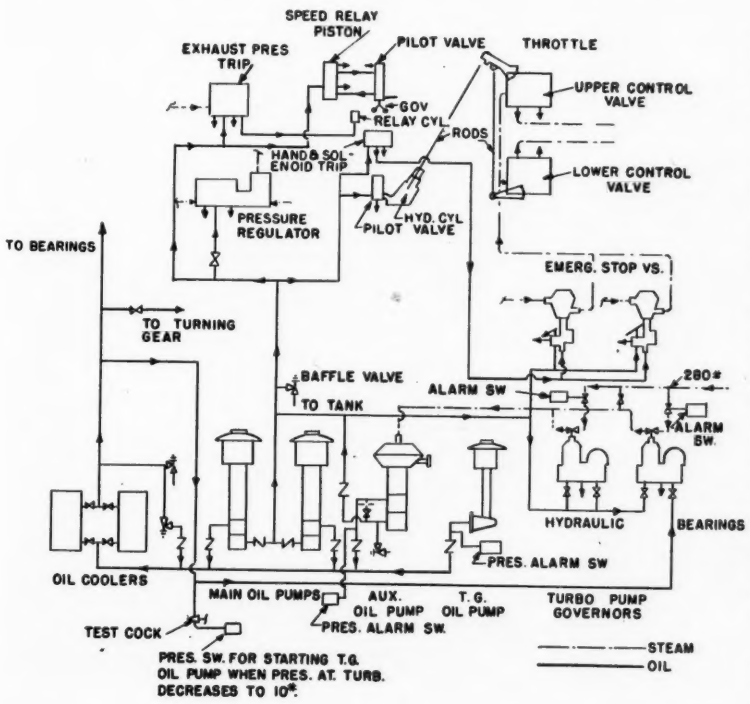


Fig. 5. Control and Oil Diagram

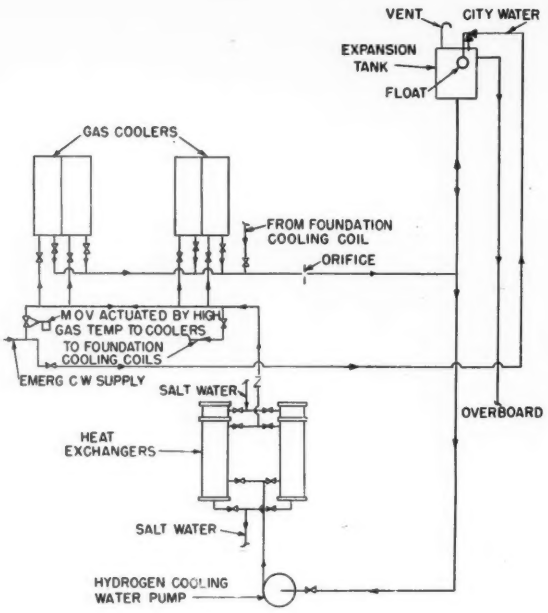


Fig. 6. Diagram showing the arrangement of the hydrogen cooling system for the electric generator

From the deaerating heater a 14 in line carries the condensate at approximately 222 F to the suction of the boiler feed pumps. The normal operating level in the deaerating heater will maintain a net positive suction head of 40 psi over the center line of the pumps which is well in excess of the minimum head required by these pumps.

Three variable speed turbine driven boiler feed pumps are provided, two for full load and one for spare. All three are Byron-Jackson 7-stage, Type HDB double casing design. The outer casing is of the barrel type and the inner is a volute horizontally split casing. The space between the inner and outer casings is subjected to full discharge pressure. The inner volute casing is under compressive stress only. The inner casing is of a double volute design to reduce radial loads and losses at low capacities. These pumps are designed to be placed in service without previous warming up. A turning gear, hereinafter described, is furnished with each General Electric turbine drive to rotate the unit at about 14 rpm. Since it is our practice to leave the suction valves open during normal standby periods, sufficient leakage through the pumps may be maintained to keep the equipment warm while on turning gear operation.

A by-pass line to the deaerator, with a suitable pressure breakdown is provided in each pump discharge. This line is open when the pump is on standby service or when pumping less than 50,000 lb per hr, to prevent flashing.

Stuffing boxes are provided with water cooled jackets using fresh water that is recovered for make-up. Flow to each stuffing box may be separately controlled to maintain proper operating temperatures.

Connections for cooling water to cage rings are provided but will be plugged unless operating experience indicates the need for additional cooling. The throat bushing in the outboard stuffing box is bled to the suction so that both stuffing boxes are under suction pressure only.

Smothering type glands with flexible piping and individual valves are provided for quenching with water from the gland cooling supply.

The boiler feed pump drives are General Electric direct connected non-condensing, non-extracting type

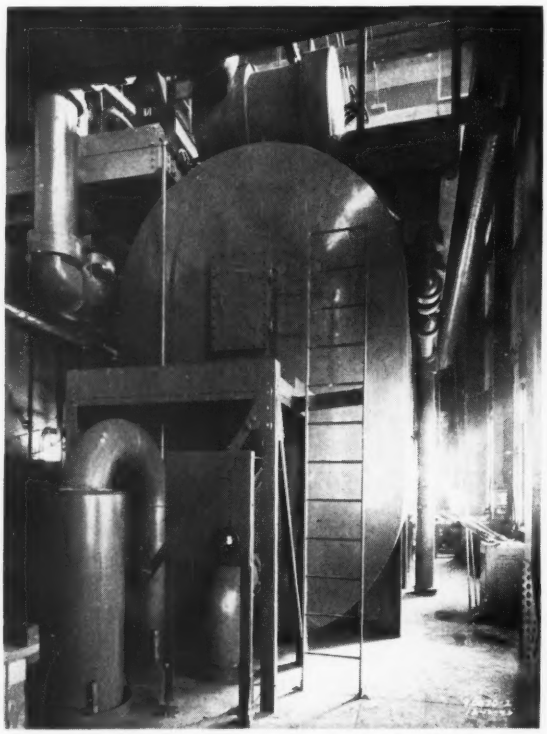


Fig. 7. The deaerating heater

Fig. 8. The high pressure closed feedwater heaters during installation

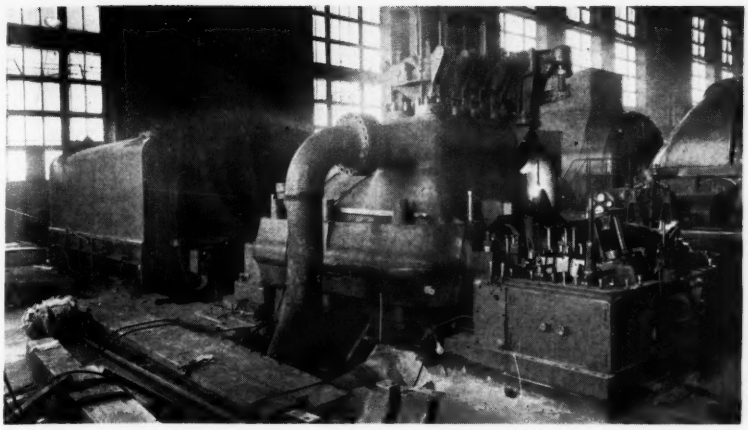


Fig. 9. View of the turbogenerator during installation

steam turbines having seven impulse stages.

Each turbine is provided with a turning gear for rotating the spindle at a speed of approximately 14 rpm during stand-by periods. These units require practically instant availability and the turning gears are provided to avoid possible shaft distortion which may result from starting turbines cold. With this arrangement the turbines will deliver full load and speed as fast as it is possible for an operator to open the throttle valve fully. Each turning gear is motor driven through a speed reducer, the worm shaft of which is extended to drive an oil pump which furnishes oil for control and lubrication during turning gear operation. These pumps also serve as auxiliary oil pumps backing up the shaft driven main turbine oil pumps through the action of a pressure switch which automatically starts the turning gear oil pumps on failure of oil pressure. The turning gears are manually engaged; automatically disengaged.

The turbines are designed to carry the maximum load of 2225 horsepower with a back pressure of 80 psig, which is the pressure at which the relief valve in the exhaust line is set. This valve is provided to limit the maximum steam operating pressure in the LP feedwater heaters to which these turbines exhaust.

The shaft driven main oil pumps are geared, positive displacement type, operating through a worm drive at about 15 per cent of the turbine speed. The pumps are located in the oil reservoir below the normal oil level, thereby eliminating the need for suction piping and oil traps for priming. Pump capacity is 20 gpm at approximately 50 psig. The pressure of the control oil is limited by means of restriction orifices as required. The bearing oil is throttled to about 10 or 15 psi by means of a hand throttle valve in the oil line down-stream of the oil coolers.

The oil that circulates through the bearings is cooled by means of Andale oil coolers; two coolers per turbine are provided, but one is sufficient for normal conditions.

Since oil under pressure is provided for all operating conditions, the sleeve bearings are not equipped with oil rings.

The boiler feed pumps will be controlled to maintain constant boiler drum level by varying the turbine speed. This control will be effected through the Bailey level controllers and Republic regulators to produce the proper turbine speed to maintain the levels as required.

Each turbine will be equipped with the usual centrifugal governors connected through an oil pilot or relay which positions the inlet valves when on constant speed operation. The normal operation, however, will be when the units are on automatic control to maintain boiler drum level, in which case the constant speed adjustment will be set for a speed slightly above the normal maximum and will therefore function only in case of failure of the independent automatic controls. Should this occur the constant speed setting would prevent over-speed by taking hold before the over-speed governor tripped out the unit.

The stream of water leaving the boiler feed pumps passes through two stages of heating before entering the boiler. The heaters are arranged in two parallel batteries so that 50 per cent of the feed stream passes through each battery. Each battery consists of one low pressure and one high pressure heater in series. When any heater is removed from service the full feed stream passes through one battery.

All heaters, of Alco design, are of the vertical "U" tube, two pass type with water channel at the bottom. Tube sheet is integral with forged water channel. Each high pressure heater is provided with a steam desuperheating zone located at the end of the second water pass.

The high pressure heaters are designed for 290 psig, 750 F on the steam side and the low pressure heaters for 100 psig, 500 F. All heaters are designed for 1600 psig on the water side. All tubing is steel, ¾ OD with a minimum wall thickness corresponding to No. 15 B.W.G. The shell of each heater is welded to the water box. Access to the tube bundle at bends is available through removal of shell cover.

Steam for the high pressure heaters is taken from the 275 psig header carrying the exhaust of the high pressure turbine. Steam for the low pressure heaters is that exhausted by the boiler feed pump turbines.

To insure an 80 lb pressure in these heaters at all loads an automatic steam make-up valve has been provided, connected to the 280 lb system.

Condensate from the heaters drain to separate external hotwells whose levels are maintained automatically. The hotwell common to the high pressure heaters is provided with a control which, through air pressure, positions a 2½-in. double seated valve to maintain level while discharging to the shell side of the low pressure heaters.

The heater drain pumps receive condensate from a collector tank which serves as a common hotwell for both L.P. feed water heaters. A 16-in. suction line splits into two 12-in. branches that connect each pump suction. This 16-in. line is oversized to minimize friction loss to pump suction, to make velocity low and to give adequate venting of steam to hotwell in case of flashing due to sudden drop in pressure. The normal operating level in the hotwell will maintain a net positive suction head over the center line of the pumps well in excess of the 25 ft minmum required by the pump manufacturer for operation at a maximum operating suction pressure of 90 psi corresponding to a saturation temperature of 331 F.

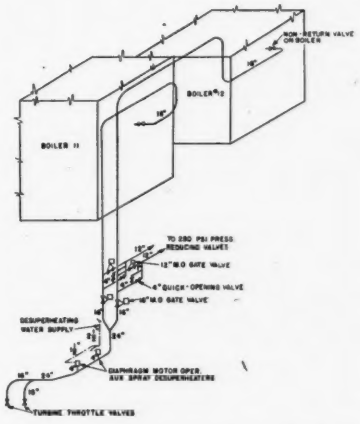


Fig. 10. Isometric diagram of the 900 psi steam leads

Two variable speed turbine driven pumps are provided; one for normal full load operation and one for spare. Both are Byron-Jackson 8-stage, type HDB boiler feed type pumps and are exact duplicates of the boiler feed pumps installed for the high pressure Unit No. 9 at Sherman Creek Station. In mechanical construction they are also similar to the Byron-Jackson boiler feed pumps provided for this unit as previously described.

The by-pass line provided for these pumps from the discharge connection to the deaerator is open when on standby service or when pumping less than 25,000 lb per hr to prevent flashing and closed when the capacity reaches this flow.

The heater drain pump drives are General Electric direct connected, non-condensing, non-extracting type steam turbines having ten impulse stages.

The heater drain pumps are controlled from the liquid level in the low pressure boiler feedwater heater hotwell. The turbine constant speed governor control mechanism is identical with that of the boiler feed pump drives as described above. Also are variable speed control superposed on this mechanism for maintaining hotwell level is similar to the variable speed controllers described for the boiler feed pump turbines.

Against the possibility of losing both the condensate pump and its spare, an emergency relief has been provided to discharge the condensate to the deaerating heater. This emergency valve must be cut in manually, after which it will control level automatically responding to the impulse sent out by a level regulator. On air failure this emergency valve closes but can be positioned by an integral jack.

Station Makeup

Station makeup, which will take care of losses due to soot blowing, blow-down, overboarded condensate, and leakages is calculated to average 200,000 lb per hr with an occasional maximum of 600,000 lb per hr. This system is arranged to take the maximum of 600,000 lb per hr from the city water header and is fed into condensers No. 2, No. 3 or No. 4 through perforated pipes located in the steam space. The amount required will be controlled through one 3 in. and one 6 in. regulating valves operating in sequence and controlled by individual regulators reflecting level in surge tanks No. 4 and No. 5. The makeup regulating valves are positioned by responding to tank level variations from 8 ft to 12 ft, 8 in. above bottom of tanks. On this basis the remaining tank capacities are available for surging action. Surge tanks 2, 3 and 4 overflows have been modified to agree with the overflow level of surge tank No. 5 by the addition of a vertical section of pipe. For emergency city water makeup service the present float operated valves have been relocated to admit water to surge tanks when tank level falls to a point approximately 6 in. from the bottom.

Heated make-up with a mixture of condensate will be discharged by the hotwell pumps to open heater No. 2. The piping is designed to handle a total of 1,000,000 lb per hr of combined condensate and makeup to this heater which is also the maximum capacity of heater. A portion of this million pound flow will go through the closed heater of whatever Unit is in operation, the remainder through the vent condensers on the open heater. With this arrangement it is necessary to operate at least one of Units No. 2, 3 or 4.

Part of the condensate discharged by the hotwell pumps of Units 4, 5, 6, 7, 8 and 9, after passing through associated bleed heaters, goes to the high pressure condensate system. The remainder enters common suction headers which form the suction system for the low pressure boiler feed pumps. All of the hotwell pumps connect on the discharge to the surge tanks, which vary in level as the feed requirements change.

The discharge from the above boiler feed pumps joins with the discharge from boiler feed pumps handling makeup and in this way a common feed system is established for all low pressure boilers. Since makeup for the entire station is provided through the boiler feed pumps handling makeup, no makeup can enter the high pressure feed system.

Steam to the open heater (No. 2) comes from the 5-lb auxiliary exhaust system, but is maintained at a constant pressure by the throttling action of a 24-in. butterfly valve at the steam inlet. This butterfly valve is automatically positioned responding to heater steam pressure. A constant level is maintained in the heater by level operated butterfly valves located in and throttling the discharge of the motor driven boiler feed booster pumps which pump the water from this heater.

The booster pumps and discharge

LIST OF EQUIPMENT

Turbine Generator

TURBINE—(1) General Electric Co., 65,000 kw @ 0.8 pf, 3600 rpm, single flow double shell 10 stage impulse type. Nominal steam at the throttle is 900 psig and 950 F exhausing at 280 psig and 672 F.

GENERATOR—(1) 65,000 kw, 0.8 pf, 81,250 kva, 3-phase, 60 cycle, 13,800 V, 3600 rpm hydrogen cooled unit with air cooled gear driven 1772 rpm 220 kw, 250-V d-c main exciter direct-connected to an air cooled 1772 rpm 4 kw, 250-V d-c pilot exciter.

Heaters

DEAERATING HEATER—(1) Cochrane direct-contact jet tray type with 2 vent condensers. Rated capacity 1,900,000 lb per hr, 18 psia with 1600 cu ft water storage; dissolved oxygen content not to exceed 0.005 cc per liter.

CLOSED FEEDWATER HEATERS — (2) sets of 2 Alco, vertical, 2-pass, U-tube heaters with a common L.P. and H.P. hotwell. Each set consists of one 3900 sq ft effective surface 100 psig 500 F low pressure heater with 400 ¾-in. O.D. 15 gage seamless steel U-tubes and one 4400 sq ft effective surface 290 psig 750 F high pressure heater with 450 ¾-in. O.D. 15 gage seamless steel U-tubes.

Pumps

CONDENSATE BOOSTER PUMPS — (3) DeLaval, single stage, double suction type designed to deliver 1480 gpm at 224 ft TDH with 23 ft positive suction head at 2820 rpm driven by Terry type ES, single stage turbines rated at 130 hp @ 3000 rpm with throttle steam @ 280 psia 675 F and exhausting @ 22 psia.

BOILERFEED PUMPS — (3) Byron-Jackson Company, horizontal, 7-stage, double case volute type. Normal full load 765,000 lb per hour, 1285 psi TDH 222 F, 3550 rpm direct connected to General Electric Co. noncondensing, non-extracting 7-stage variable speed impulse turbines with automatic turning device. Steam 280 psia 675 F and 95 psia exhaust pressure.

L.P. HEATER DRAIN PUMPS — (2) Byron-Jackson Company, horizontal, 8-stage, double case volute type. Normal full load 305,000 lb per hour, 1250 psi, TDH @ 3440 rpm, direct connected to General Electric noncondensing, non-extracting 10 stage variable speed impulse turbines with automatic turning device. Steam 280 psia, 675 F and 22 psia exhaust pressure.

SALT WATER PUMPS—(3) Ingersoll-Rand Company, 2-stage, vertical, mixed flow, 6,000 gpm, 90 ft TDH, 25 psig discharge pressure pumps, direct connected to 200 hp, 1750 rpm, 2300-V, 3 phase, 60 cycle totally enclosed, fan-cooled Westinghouse vertical motors.

SALT WATER BOOSTER PUMPS—(3) DeLaval 2-stage, single suction, opposed impeller type rated at 1250 gpm at 300 ft TDH with a 35 ft suction head at 2400 rpm, driven by Westinghouse impulse type C-225 turbines rated at 146 hp at 2550 rpm with 280 psia, 675 F steam and 15 psia exhaust and provided with hand operated speed changer for ± 10 per cent range.

HYDROGEN COOLING WATER PUMPS—(1) Goulds single stage, double suction, centrifugal pump rated 400 gpm @ 75 ft TDH driven by a 15 hp, 1760 rpm, 208-V, 3 phase, 60 cycle Westinghouse direct connected totally enclosed fan cooled motor.

to the suction of the boiler feed pumps which, as noted above, deliver a mixture of makeup and condensate to the low pressure boilers.

Piping

Main Steam, Pressure Reducing, and Desuperheating Systems

Each boiler has a 16-in. steam lead which runs to a point approximately at the division wall, where they combine into one 24-in. pipe so that any differences in temperature from the boilers can be equalized before splitting into two 16-in. turbine connections. (See Fig. 10.) For washing the turbine under load, two connections are made on the 24-in. pipe for desuperheating water spray.

In each of these take offs there is a 12-in. motor operated gate valve with a 4-in. solenoid trip-operated, quick opening valve in parallel. These valves open automatically when the pressure in the 280 lb steam header drops to 270 lb. The 12-in. valves are set for automatic operation, with manual control from the boiler control room in addition. To guard against automatic opening of the 12-in. gate valve and the 4-in. quick opening valve when the boiler is off the line, a selector switch is provided so that either one group of valves or both may be made inoperative.

The 4-in. valve is designed to permit locking the valve against accidental opening when its respective boiler is off the line.

To keep the line warm, the 4-in. valve is arranged with a 1-in. by-pass to admit steam of high pressure and temperature to the upstream side of the pressure reducing valves when the 4-in. and 12-in. valves are in a closed position.

The 4-in. and 12-in. valves are used as shut-off valves for the pressure reducing valve.

The pressure reducing valves manufactured by Republic Flow Meters Co. have a capacity of 1,000,000 lb steam per hour each from 925 psig to 280 psig.

For the control of the pressure reducing valves there is one air operated measuring regulator receiving its impulse from the 280 lb steam header, arranged to provide a loading pressure for transmission to the regulator mounted on the pressure reducing valve.

The desuperheaters are of the venturi type with spray pipe through a nozzle connection. The spray is in the direction of steam flow.

Desuperheating water is controlled through a lever operated single seated valve, actuated from a temperature regulator. This is first actuated by a link connected to the regulator on the pressure reducing valve. With this connection any change in the pressure reducing valve will immediately cause a change in water flow to the desuperheater.

To correct the position of the temperature regulator for proper flow of water, a bimetallic temperature measuring element for loading pressure is installed approximately 35 ft downstream from the desuperheater.

Pressure and temperature regulators are provided with an oil trapping valve designed to retain the pressure reducing valve and the water control valve in their last operating positions should an oil supply failure occur.

Mounted on the boiler control board is a mercury indicating manometer which indicates the loading pressure transmitted to the two reducing valve regulators. With this arrangement it will be possible to set up a proportion between the two valves by means of the ratio valves located adjacent to the indicating manometer. This proportion will be maintained throughout the operating range of the system. Individual remote manual control sub-panels are installed on the bench boards for positioning the system and water control valves from the boiler control room.

Mounted on a panel in back of the boiler control board are two sets of high pressure safety control equipment (one for each boiler lead) each including one measuring element and one bleed relay. These function in the event that the pressure upstream of the pressure reducing valves falls below 850 psi. When this occurs the pressure measuring element will operate the relay which in turn reduces the loading pressure to the valve operator and closes the valves as required to maintain the desired pressure.

The 280 lb exhaust from the turbine is 36-in. pipe, ⅞-in. wall thickness up to the interconnection with the high temperature, high pressure main steam leads and continues from this point in 30-in. pipe of 1-in. wall thickness to the roof of the turbine room. There it passes through a 30-in. expansion joint and at its south end feeds with three 24-in. leads into the east wall header.

This expansion joint is of the sliding type and can be unpacked and repacked under operating pressure. Piston rings hold the line pressure during unpacking and steam which passes the rings is collected in vent chambers from which it can be exhausted into atmosphere through two 1-in. vent lines.

Steam from this system supplies the various turbine drives and the high pressure closed feedwater heaters and through a pressure reducing valve maintains 80 lb on the low pressure closed feedwater heaters, in addition to tying into the present low pressure turbine header.

The system is protected by 13 safety valves located on the turbine room roof and exhausting directly into atmosphere.

Starting Procedure

The generating unit may be started either with full boiler pressure from a boiler or boilers already on the line with the pressure reducing station or by bringing a boiler and the turbine up together.

In the former case the turbine is rotated on turning gear. The above-seat drains are opened to remove any moisture which may have accumulated on the main steam leads ahead of the stop valves. The below seat drains and the casing drains are opened, also, to remove any condensate which may have accumulated in the turbine. The steam jet exhausters on the glands should be placed in service and then the 4-in. by-pass around the 30-in. gate valve in the exhaust should be cracked to allow 280-lb steam to enter the casing through the exhaust. The 4-in. valve is gradually opened so that the casing will come up to 280 lb pressure and become uniformly heated to the temperature of the station steam. The 30-in. gate valve must then be opened so that the interlock will allow the opening of the stop valves.

The main oil pump should then be started and the trip relatched. This will open the stop valves. The turbine may now be started by operating the starting handwheel, thereby opening the control valves. The opening of the valves should be controlled so that the machine will not warm up at a rate greater than that specified by the manufacturer.

The various starting drains and the 4-in. by-pass should be closed. The unit may now be brought up to synchronous speed and placed on the bus, shutting off the gland ejectors when the water seals are established.

When boiler and turbine are brought up together the above procedure is modified slightly. The boiler is started up with the main steam and above-seat drains open. Only when the pressure is built up to about 400 psi and the above-seat drain thermometer indicates dry or superheated steam should the stop valves be opened. Meanwhile the casing drains, the 4-in. by-pass, and the 30-in. gate valve have been opened as described above.

The unit may now be started by use of the starting handwheel at the reduced boiler pressure, closing the drains. As the boiler pressure increases the unit speed is brought up until it is possible to synchronize it and put it on the bus. The boiler pressure and temperature may then be further increased as load is picked up, up to the designed throttle conditions.

This latter method of starting allows the turbine to carry load more quickly than the first method because of the lower temperature at which it starts. However, the method of starting selected must depend on the availability of the boilers. If only the turbine is out and the boilers have continued in operation, the first starting procedure must be followed. If both boilers have been down, the latter method is advisable.

Floating Power

The floating power plants described here were announced in 1942 but outside of their capacity and general features little was published about them while the war was on. Now that fighting has ceased this more complete description has been made available. Of particular interest is the fact that although these floating plants were designed for use on the rivers and lakes of this country, they were actually towed across the oceans to supply electric power to devastated areas abroad.

By W. N. Oberly

Unit Equipment Division, General Electric Co.
Schenectady, N. Y.

OF THE 120,000 KW of floating power located in four barges originally designed and built to serve power shortage areas which might have developed in this country, three power plants were taken over by the War Department and used in foreign countries to serve bombed out areas. Two of the 30,000-kw plants were located in Belgium and supplied almost half of the electric power in that country for some time. The third plant was operating in the Pacific area.

For foreign operation, the turbines were changed over to operate at 50 cycles and a frequency changer set was installed to allow operation of the auxiliaries at 60 cycles. A bow and stearing gear was added to the barges for ocean crossing.

Preliminary designs and much thought had been given to building power plants of this type prior to the start of the war. In November, 1940, Mr. A. P. Kellogg, General Electric Co., presented before the Wisconsin Utilities Association at Milwaukee the proposed design of a 50,000-kw floating power plant and its uses in times of war. In 1942, the U. S. Government ordered the four 30,000-kilowatt floating power plants to be built and placed in operation by 1943. This program was fostered by the Power Division of the War Production Board. The Power Division proposed to use these plants in places where power shortage occurred, to back up overloaded systems, or even to supply power to bombed vicinities.

The practicability of such arrangements as generators of electric power was proved when the U. S. S. Lexington supplied the city of Tacoma, Washington, with emergency power in 1929. In 1930, the Public Service Company of New Hampshire placed the power ship "Jacona" in operation and it has operated almost continuously along the New England Coast.

In developing the design for the 30,000-kw floating power plants, a study made of the various coastal and inland waterways indicated that a draft of nine feet, a beam of 50 ft, and a length of approximately 300 ft would permit the barges to pass through most of the nation's inland waterways touching the important industrial centers. For example, they can be towed to such cities as New Orleans, Memphis, and St. Louis on the Mississippi. They can be towed through the Illinois River to Chicago and then into the Great Lakes to Milwaukee, Detroit, Cleveland, and Buffalo. In addition to serving inland cities, the barges are capable of skirting the Atlantic Coast for service in coastal areas.

Stacks are removable at the deck so that the barge can clear low bridges in transit. A double bottom is built into the barge which can be used for fuel oil, water storage, or ballast. It may be desirable to lighten the barge when passing through shallow channels or weight it when going under low clearances. The fuel oil carried on the barges is ample for preliminary operation while supply barges are in transit.

The barge has accommodations for operating crew, operating offices, locker rooms, and mess hall. A navigation crew is not required since the

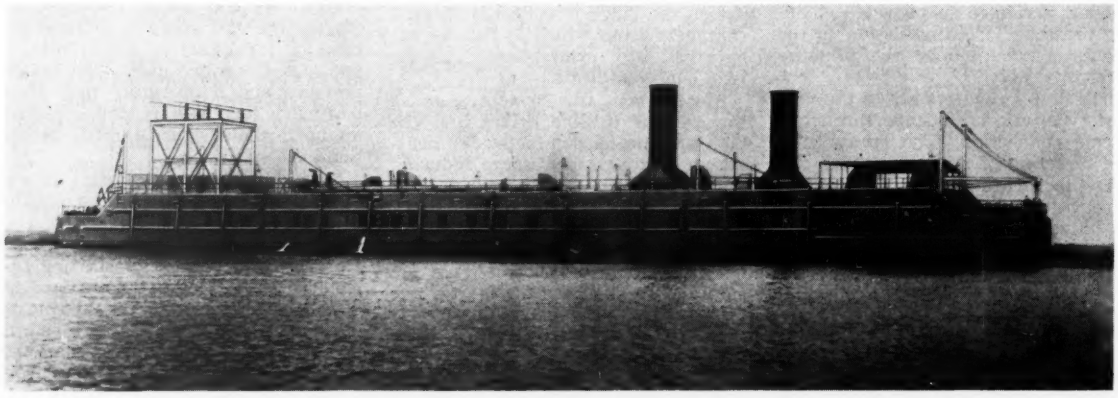


Fig. 1. One of the 30,000-kw floating power plants. Length, 318 ft; width, 50 ft; draft, 9 ft

barge is towed to the location where power is needed. The barge is equipped with two boilers of the marine type, each rated 170,000 lb per hr at 835 psi gage, 910 F total temperature with feedwater being supplied the boiler at 350 F. Each boiler is located in a separate water-tight compartment, complete with all its controls.

One special feature of these boilers is a divided furnace construction for superheat control. Two groups of oil burners are located in the furnaces; one to supply heat to the convection portion of the boiler, and the other to the superheater portion. Superheat can be controlled accurately by the use of this separate group of burners. Constant superheat is thus obtained down to 50,000 lb per hr flow.

Another feature of the boilers is the pressure type furnace with double wall casings. Air is circulated within the casing, and is held at combustion air pressure to prevent gas leakage into the boiler room. The air within the casing also serves to cool the furnace walls.

The boilers have both an air-preheater and economizer which give high boiler efficiency. Complete automatic combustion control is installed conforming to general central station practice. Multiple steam mechanical burners are provided to give a wide range of operation at high efficiency.

The turbine-generator for each barge is rated 30,000 kw, 0.8 power-factor, 3 phase, 60 cycle, 3600 rpm, 13,800 v. The turbine is a single-flow, single casing machine with a bottom exhaust. Steam is extracted from four points in the turbine for heating the boiler feedwater and for evaporating make-up water. The initial steam conditions are 825 psi gage, 900 FTT. The pressure and temperature chosen are considered good central station practice for units of this size. Volume flows are sufficient with a unit of this size so that the pressure and temperature chosen result in turbine parts, such as valves, nozzles, and buckets, which are well proportioned.

The turbine is of the horizontal shaft, multi-stage type of a design and construction which has provided its reliability and continuous efficiency in units of comparable type operating under comparable conditions.

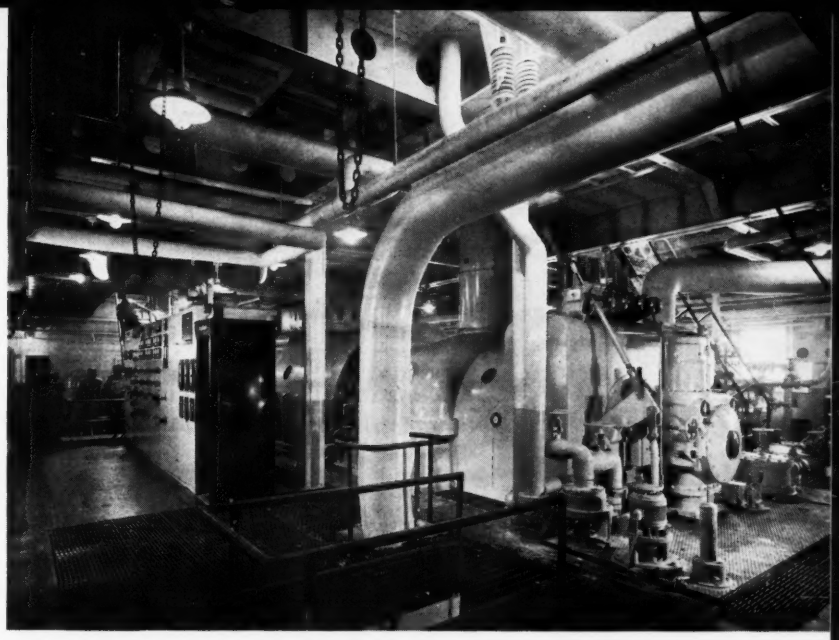


Fig. 2. An interior view of one of the floating power plants. This shows the 30,000-kw G. E. steam turbine-generator set and the switchboard

The unit is a four-bearing set with a solid coupling between the turbine and generator. The turbine shell is of cast steel, split horizontally, with a four-way joint at the flange connection to the exhaust hood. The exhaust hood is of cast iron with an opening at the bottom. The control valve casing is an integral part of the high-pressure shell.

The turbine rotor consists of a solid alloy steel forging with all wheels machined integral with the shaft. Due to the extended surface of the solid rotor and the close proximity of the diaphragms, the rotor expands and contracts easily and unformly at about the same rate as the shell, thereby maintaining axial clearances.

High efficiency is maintained over a wide range of load by use of multiple control valve construction. All steam admission valves are under control of the operating governor which is of the centrifugal type and is driven by the turbine shaft through a worm and gear. The motion of the governor weights is transmitted by a hydraulic mechanism to the control valves, which regulate the flow of steam to turbine. The turbine is provided with an emergency overspeed governor which is mounted at the head end of the turbine and is normally set to operate at 110 per cent of rated speed.

Main generators are hydrogen-cooled with surface gas coolers built into the generating casing. The general acceptance of hydrogen cooling is due to numerous advantages. Because of the lower density of hydrogen, windage losses are about ten per cent of those for an air-cooled generator. Hydrogen has a thermal conductivity seven times that of air and as a result greater output can be obtained with the same active material. The effect of corona on insulation is negligible in hydrogen and the insulation retains its flexibility longer. Another important fact is that since hydrogen will not support combustion, fire hazard is minimized.

The generating stator frame is a welded structure fabricated from steel plate. Annular plates are welded to the inside of the wrapper plate for supporting the armature core and winding. The radial depth of the core is made greater than is required by electrical considerations, thereby producing an extremely rigid structure.

The rotor is made from a steel forging having radial slots machined in it for the windings. Ventilating slots are machined in the rotor forming passages for circulating hydrogen along the entire length of the core section. Directly connected to the

(Continued on page 71)

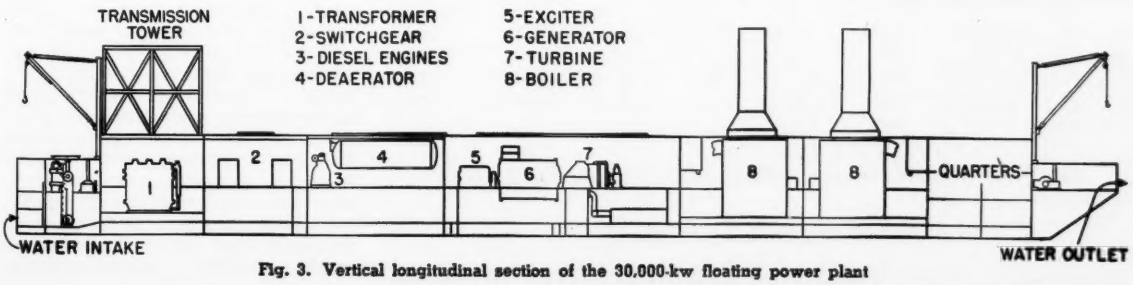


Fig. 3. Vertical longitudinal section of the 30,000-kw floating power plant

What the Power Engineer Needs to Know About

THE BUCKET ELEVATOR

How the elevator is constructed and how it works ... The life of the elevator is the life of the chain ... Comparison with other conveying machines for coal and ash handling ... How to calculate capacity and power required . . . Controlled feed is important

By

Wilbur G. Hudson

Consulting Engineer

CHAIN AND BUCKET elevators are standardized as:—

High-speed centrifugal discharge
Medium-speed perfect discharge —infrequently used in boiler house work
Slow-speed continuous bucket
Medium-speed or slow-speed gravity discharge.

Belt and bucket elevators are either centrifugal discharge or continuous bucket.

Most of the coal handling problems involve a choice between a bucket elevator and a skip hoist, inclined conveyor, or a continuous-flow machine. The higher the lift, the better the skip hoist shapes up, with the latter favored when the coal will be lumpy or actively corrosive. An inclined conveyor—a belt if the inclination does not exceed 18 deg, or a flight conveyor for inclination up to 25 deg or so—has some advantage over the elevator if the coal is small size (minus ¼ in.) and sticky, because such coal builds up in the buckets, is difficult to remove and reduces the capacity of the elevator.

Comparisons with Other Machines

The elevator costs substantially less than an inclined conveyor with supporting structure and, while it has a shorter life and higher maintenance costs when handling abrasive materials, it compares well for coal-handling duty. The gravity-discharge elevator with vertical and horizontal runs is less frequently specified now, since it costs less to couple an elevator with an overhead conveyor. The continuous flow elevator-conveyor was discussed POWER PLANT ENGINEERING, November, 1945, page 95.

A vertical elevator is preferred to one with an inclined run since, in the latter, the chains slide or run upon guides, which are a source of trouble when worn thin. A slow-speed continuous bucket elevator is preferred to a high-speed centrifugal-discharge machine except for small capacities and lifts. The reverse is true with belt and bucket elevators because there is less wedging of coal between buckets and belt.

Required motor hp (except for gravity discharge elevators) can be approximated by the formula:—

$$\text{Motor hp} = \frac{\text{tph} \times 2 \times \text{lift in feet}}{1000}$$

Elevators usually have self-supporting casings of sheet steel and corner angles, though asbestos-cement sheets have some favor. In normal times, copper-bearing steel is desirable because of somewhat greater resistance to corrosion than plain steel at 10 per cent or 15 per cent higher first cost. Wood casings introduce considerable fire risk and are subject to decay. Since the reversal of a loaded elevator means a bad mess at the boot, an automatic brake is necessary.

Life of Chain

The life of an elevator is the life of the chain, usually its most costly part. For single strand elevators, the malleable iron "combination" chains are favored as being low in cost and having wide bearing surfaces. The large double strand machines, Fig. 1, may have bushed steel "engineering" chains with provision for lubricating the articulations. If the grease ducts are closed by ball-type fittings coal dust works in, plugs the duct and soon makes further lubrication impossible.

It is an open question whether it is better to lubricate an elevator chain or to have the surfaces extremely hard and unlubricated. Heavy double-strand elevators may have steel guides extending full length to confine the element if one or both should fail. These guides serve as emergency protection against strain and distortion in the event of a breakdown.

For handling ashes, the centrifugal discharge chain and bucket elevator is preferred because it is lowest in cost. As a rule, the lift and capacity are small and long life is not expected. Malleable iron chains and buckets provide good resistance to corrosion.

Table 1. Capacity of vertical centrifugal discharge elevators and maximum size of lumps

Sizes of buckets; maximum lumps; capacities, buckets 75 per cent filled.

Bucket Spacing, inches	Size, Length by Width	Speed, feet per minute	Max. Lumps All Lumps	Max. Lumps 10% Lumps	Capacity in Tons per Hour 35-Lb. Material	50-Lb. Material	100-Lb. Material
13	6 × 4	225	½	2½	5	7	14
16	8 × 5	230	¾	3	9	13	27
16	10 × 6	230	1	3½	16	23	47
18	12 × 7	268	1¼	4	27	38	77
18	14 × 7	268	1¼	4	32	46	92
19	16 × 8	262	1½	4½	44	63	127

Horsepower: Motor horsepower for centrifugal discharge elevators closely approximates

$$\frac{\text{Tons per hour} \times 2 \times \text{Lift in feet}}{1000}$$

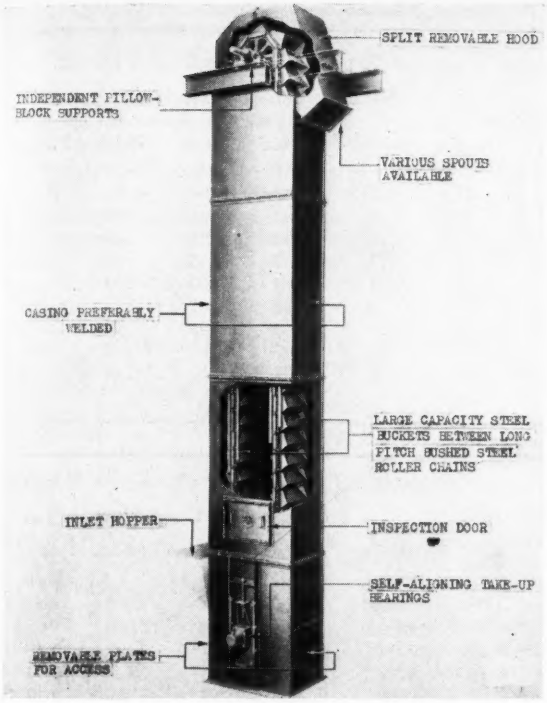


Fig. 1. Construction details of a double-strand, vertical, continuous bucket elevator (Photo courtesy Link-Belt Co.)

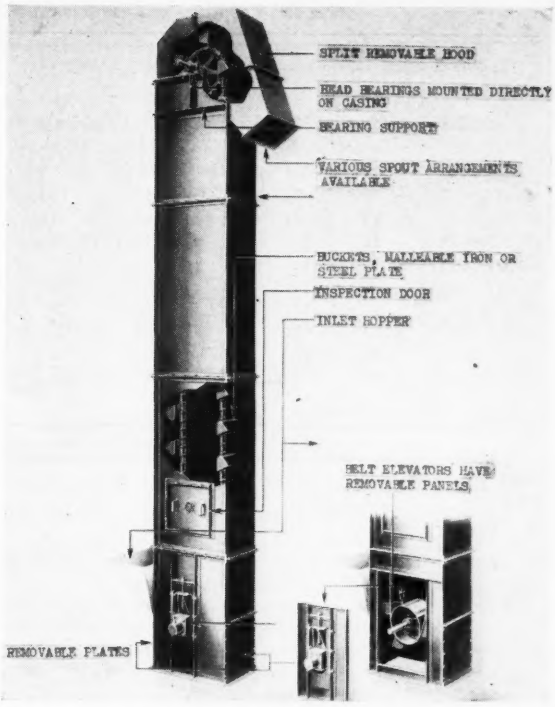


Fig. 2. Centrifugal discharge bucket elevator with fixed head bearings, adjustable boot bearings (Photo courtesy Link-Belt Co.)

Controlled Feed Important

One important factor in the satisfactory performance of an elevator is a controlled feed. The centrifugal-discharge ash elevator receiving small batches, as from a wheelbarrow, needs no feeder, for the buckets scoop up what they can and clear the boot in a few seconds. But a coal-handling elevator must be fed at a fixed rate.

The continuous bucket elevator must be fed after the buckets line up for the lift. Sometimes the feeder is driven from the elevator foot-shaft, but if it has a separate motor drive, the elevator motor and feeder motor must be interlocked so that if the former is released by the functioning of the shear pin, the feeder will instantly stop.

A track hopper and feeder ordinarily call for a pit depth of 10 ft or 12 ft. Sometimes conditions at the site make such depth inconvenient, and it is possible to reduce this depth to 2 ft or 3 ft, with smaller width and length, by a bar-flight feeder as shown in Fig. 2, page 93, The Flight Conveyor, POWER PLANT ENGINEERING, October, 1945. This shallow type track hopper is seldom specified when the capacity is more than 30 tph since it has obvious limitations. A considerable part of each carload must be shovelled in and, if a breakdown should occur, it may be necessary to remove rails and track beams to get at the trouble. It is not suited to lumpy coal.

The old drive group with a motor geared to a countershaft, which is geared in turn to the head shaft, is seldom seen (and heard) now. The motorized reducer brings the speed down to where a further reduction of three or four to one by chain drive provides a drive that is practically noiseless and facilitates a change in elevator speed by the substitution of a different small sprocket. Moreover the motor can be located where inspection is more convenient.

Power and Capacity Charts

To calculate capacities and power requirements of various types of bucket elevators, data are given in Tables I to V.* Capacities of vertical centrifugal-discharge elevators and maximum size of lumps are given in Table I. Capacities and horsepower for gravity-discharge elevators, when handling coal, are shown in Table II. Table III gives the capacities and horsepower for the smaller sizes of

*See Conveyors and Related Equipment, by Wilbur G. Hudson; John Wiley & Sons, New York, for additional tables and detailed discussion.

Table II. Capacities and horsepower of gravity-discharge elevators, handling coal[1]

(Used primarily for bituminous coal)
Capacities in tons per hour at 100 ft. per min. Buckets loaded to 80 per cent of level full.

Size of Bucket, inches $L \times W$	Capacity in tons per Hour at 100 Ft. per Min.			Horsepower[2] with Material at 50 Lb. per Cu. Ft.					
	Bucket spacing, inches			Per 10 Ft. Vertical Lift			Per 100 Ft. Horizontal Run		
				Spacing of Buckets, inches					
	18	24	36	18	24	36	18	24	36
16 × 15	46	35	23	0.59	0.44	0.30	5.32	4.24	3.04
20 × 15	58	44	29	0.74	0.56	0.37	6.32	4.97	3.54
24 × 15	70	52	35	0.90	0.67	0.45	7.34	5.74	4.04
20 × 20	104	..	52	1.30	. ..	0.66	9.20	....	4.85
24 × 20	125	..	63	1.60	....	0.80	10.92	....	5.74
30 × 20	159	..	79	2.00	....	1.00	13.70	....	7.08
36 × 20	191	..	95	2.42	....	1.21	16.30	....	8.40

[1] Source: Link-Belt Company.
[2] Add 5 per cent to horsepower for each bend in path of loaded run.

Table III. Capacities and horsepower for smaller sizes of continuous bucket elevator[1]

Bucket sizes; maximum lumps; capacities; horsepower. Capacities with buckets 75 per cent full; speed, 125 ft. per min.

Buckets		Max. Lumps		Capacity in Tons per Hour				Horsepower Required For Each Foot of Centers				
Size	Gauge of Steel	All Lumps	10% Lumps	35-Lb. Material	50-Lb. Material	75-Lb. Material	100-Lb. Material	For Terminals	35-Lb. Material	50-Lb. Material	75-Lb. Material	100-Lb. Material
8 × 5 × 7¾	12	¾	2½	12	17	25	34	0.1	0.02	0.03	0.04	0.05
10 × 5 × 7¾	12	¾	2½	15	21	32	42	.1	.03	.04	.05	.07
10 × 7 × 11⅝	12	1	3	19	27	41	54	.1	.03	.04	.07	.09
12 × 7 × 11⅝	10	1	3	23	32	49	65	.1	.04	.05	.08	.10
14 × 7 × 11⅝	10	1	3	26	38	57	76	.1	.04	.06	.09	.12
12 × 8 × 11⅝	10	1¼	4	27	39	58	78	.2	.05	.07	.11	.13
14 × 8 × 11⅝	10	1¼	4	32	45	68	91	.2	.05	.08	.12	.14
16 × 8 × 11⅝	10	1½	4½	36	52	78	104	.2	.07	.09	.13	.16
18 × 8 × 11⅝	10	1½	4½	41	58	88	117	.2	.08	.11	.14	.18

[1] Source: Link-Belt Company.

Table IV. Capacities and horsepower for large continuous bucket elevators

Sizes of buckets; maximum lumps, based on 10–20 per cent of lumps in material; capacities at 100 ft. per min. with buckets 75 per cent full; horsepowers at head shaft.

	Size of Buckets, inches	Maximum Lumps[2]	Capacities in Tons per Hour			Horsepower 50-Lb. Material		75-Lb. Material		100-Lb. Material	
			50-Lb. Material	75-Lb. Material	100-Lb. Material	Terminals	Each Foot of Centers	Terminals	Each Foot of Centers	Terminals	Each Foot of Centers
Chain pitch[1] 12 in.	12 × 8 × 11½	6	60	90	120	0.37	0.09	0.55	0.14	0.74	0.19
	16 × 8 × 11½	6	80	120	160	0.49	0.12	0.73	0.18	0.98	0.24
	20 × 8 × 11½	6	100	150	200	0.61	0.15	0.92	0.23	1.23	0.31
	16 × 12 × 17½	8	115	175	230	0.77	0.17	1.15	0.26	1.54	0.34
Chain pitch 18 in.	20 × 12 × 17½	8	145	220	290	0.99	0.22	1.48	0.33	1.97	0.44
	24 × 12 × 17½	8	175	260	345	1.19	0.27	1.73	0.40	2.38	0.53
	30 × 12 × 17½	8	215	320	425	1.44	0.32	2.16	0.48	2.89	0.64
	36 × 12 × 17½	8	255	385	510	1.73	0.38	2.60	0.58	3.47	0.77
Chain pitch 24 in.	24 × 17 × 23½	10	230	345	460	2.11	0.35	3.16	0.53	4.22	0.71
	30 × 17 × 23½	10	285	430	570	2.65	0.44	3.97	0.66	5.29	0.88
	36 × 17 × 23½	10	345	520	690	3.20	0.52	4.79	0.79	6.39	1.06

[1] These are the long-pitch engineering chains.
[2] Not over 20 per cent large lumps.

continuous bucket elevators and Table IV for large continuous bucket elevators and Table V gives the capacities and maximum lump sizes for centrifugal-discharge belt and bucket elevators. The power requirement is the ame as for the chain type centrifugal discharge elevator.

Problems in Selecting Elevator

1. Select an elevator to handle 50 tons per hour of crushed bituminous coal vertically a distance of 60 ft and specify the size of motor.

The coal weighs 50 lb per cu ft. By Table 1, we see that the capacity is easily attained with a centrifugal discharge elevator, so it is not necessary to specify the more costly continuous bucket type. By the table we find that a machine with 16 by 8-in.

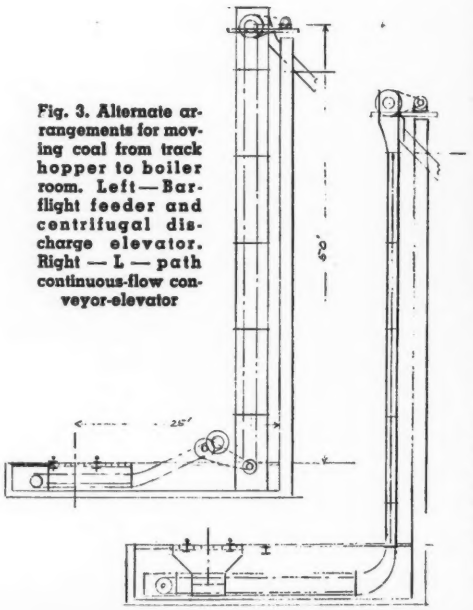


Fig. 3. Alternate arrangements for moving coal from track hopper to boiler room. Left — Barflight feeder and centrifugal discharge elevator. Right — L — path continuous-flow conveyor-elevator

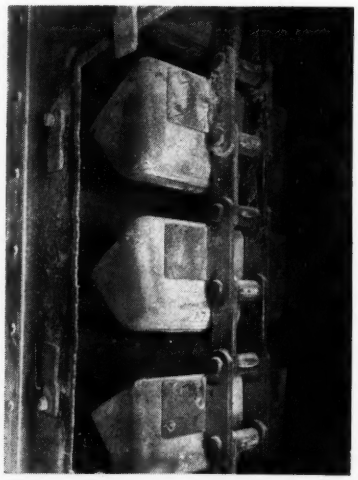


Fig. 4. High quality centrifugal discharge elevator, ascending leg. Buckets of malleable iron, chain 6-in. pitch, ultimate strength 100,000 lb. Side bars are medium carbon heat-treated steel. Bushings and bins reversible, both heat-treated alloy steel. Photo taken after elevator had handled 7,000,000 tons of cement clinker without requiring any repairs. (Photo courtesy Link-Belt Co.)

buckets spaced 19 in., at a speed of 262 ft per minute, has a capacity of 63 tons per hour. The motor horsepower is

$$\frac{50 \times 2 \times 60}{1000} = 6 \text{ hp.}$$

The nearest motor is 7½ hp.

2. Select an elevator to handle 150 tons per hour with a 60-ft lift.

This capacity is altogether too much for a centrifugal discharge elevator, hence we refer to Table 4. We see that for 50-lb material, a machine with 20 by 12 by 17½ in. buckets and a speed of 100 ft per minute will have a capacity of 145 tons per hour. So this elevator, with a speed slightly above 100 ft per minute, would be specified. The table gives the horsepower at the head shaft for each foot of centers as 0.22, and the loss at the terminals as 0.99. For the motor horsepower, we will add 10 per cent for drive loss plus 10 per cent for starting overloads, thus: 0.99 + (0.22 x 60) = 14.2 hp.

14.2 + 1.42 + 1.42 = 17.2 hp, approximately.

Our approximate formula gives—

$$\frac{150 \times 2 \times 60}{1000} = 18 \text{ motor hp.}$$

In either example, if a feeder is driven from the elevator foot shaft, an allowance must be made for the power absorbed there, which may be considerable if the feeder is long and inclined upward from beneath a track hopper.

Table V. Capacities and maximum lump sizes for centrifugal-discharge belt and bucket elevators

Bucket Spacing, inches	Size, Length by Width	Speed, feet per minute	Maximum Lumps All Lumps	Maximum Lumps 10% Lumps	Capacity in Tons per Hour 35-Lb. Material	Capacity in Tons per Hour 50-Lb. Material	Capacity in Tons per Hour 100-Lb. Material
13	6 × 4	225	½	2½	5	7	14
16	8 × 5	258	¾	3	11	15	30
16	10 × 6	258	1	3½	18	26	52
18	12 × 7	298	1¼	4	30	42	85
18	14 × 7	298	1¼	4	36	52	103
18	16 × 8	298	1½	4½	53	114	152

Link-Belt recommends 32-oz. belt up to and including 10-in. buckets.

Horsepower: Motor horsepower for centrifugal-discharge elevators closely approximates

$$\frac{\text{Tons per hour} \times 2 \times \text{Lift in feet}}{1000}$$

Consideration of Alternatives

Illustrating the desirability of considering costs, Fig. 3 shows a recent problem. Here it was desired to handle minus ½-in. bituminous coal from cars at 20 tons per hour up to a point calling for a 50-ft centers elevator, with discharge to within the boiler room.

At the left of Fig 3 is the typical bar-flight feeder—centrifugal discharge elevator combination. From Table I this will be a 10 by 6-in. machine at 230 ft per minute, calling for 2 motor hp. In addition, we will allow 2 hp for the feeder, or a 5-hp motor. The estimated cost was $3,900 erected.

At the right of Fig. 3, a single L-path continuous-flow conveyor unit is shown. (See November issue, Figs. 8 and 10, pages 97 and 98.) This requires 5.5 motor hp and operates at 50 ft per minute. The estimated cost was $2,950 erected.

Whether the higher-priced installation is warranted depends on the characteristics of the coal. If it is dry and clean, the continuous-flow unit is suitable. If it is damp, contains bug-dust and therefore is abrasive, and—most important—if it is corrosive, the feeder-bucket elevator combination should be selected.

Floating Power

(Continued from page 59)

main generator are the main exciter and pilot exciter, which are cooled by a surface air cooler mounted beneath exciters. The main exciter is of the one-bearing type connected to the end of the generator rotor by means of a single reduction gear. A solid coupling is used between the exciter and gear so that the gear bearing supports one end of the exciter armature. A flexible coupling is used between the gear and the general rotor. The pilot exciter is overhung from the end of the main exciter.

Two condensers per barge are of the horizontal tube, single-pass type. They are placed on each side of the turbine exhaust and connected by means of a Y. It is important to have the circulating water inlet and discharge far enough apart and at different water levels so that there will be no danger of the hot discharge water heating up the inlet water. In waters where there is a continuous current, the barge may be turned so that the discharge water is carried downstream, thereby assuring cool inlet water. Water is taken in at the stern of the barge below the water line and passed through rotating screens which prevent foreign materials from passing into the circulating pump and condenser. These screens are self-cleaning by the continuous rotation. The water then passes through ducts located on both sides of the barge to the condenser. It is discharged at the bow above the water line.

Auxiliary equipment is similar to usual central station practice. There are two motor-driven boiler feed pumps and one steam-driven unit. Each furnace is supplied with one forced draft fan. The feedwater heating cycle employs a high and low pressure surface heater and deaerator. Two make-up water evaporators are used, as well as a motor-driven fuel oil pump and surface type fuel oil heater. The steam required for fuel oil heaters as well as heating the oil on the barge is taken from a separate evaporator system. A cooling water system was installed so that salt water or poor fresh water could be used for all cooling purposes on the apparatus.

The electric equipment is of the standard metal-enclosed type as used in modern central stations. The generator leads are taken off at the top of the generator instead of below the floor to keep main electric connections above any emergency water level. The 13.8-kv leads are connected to an enclosed bus run which travels along the top of the generator room level. Along the run of this enclosed bus are located tap-off connections to a generator neutral ground reactor, generator protective equipment, auxiliary power transformers, potential transformer compartments, and lightning protective equipment.

The generator neutral ground reactor limits the short-circuit current to ground faults and the generator protective equipment reduces the severity of incoming voltage surges. The potential transformer compartments are used in connection with metering, relaying, and voltage regulation. The two 1500-kva unit substations consist of transformers stepping down from generator voltage of 13,800 to 480 and metal clad auxiliary switchgear containing air circuit breakers. These in turn supply two interconnected auxiliary feeder lines transmitting power to all of the motor-driven auxiliaries.

The main generator switch is of the metal-enclosed oil circuit breaker type with disconnect switches located within the metal enclosure.

An interesting feature of the design is that the main control board, the turbine control board, and the hydrogen generator cooling board are all located in the generator room beside the generator so that the operator may have control of the electric equipment in one room.

A main power transformer is located on the barge so that power can be taken off at voltage common to

(Continued on page 84)

Application of Electric Motors to Power Station Auxiliaries

By A. E. BEARDMORE

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Part 1 . . . Motor selection . . . Drip-proof motors . . . Fan-cooled motors . . . Totally enclosed motors . . . Ambient temperature . . . Importance of inertia . . . Current and torque characteristics . . . Suggested voltage limits . . . Voltages for various size motors.

THE DEGREE of reliability required of a generating station is determined by the type of community or industrial section it serves, and by its relation to other sources of supply for the system. The demands of a metropolitan business section, for example, or the operations of some processing industry make it imperative that the power supply be continuous, and that power stations serving such communities should be designed for the greatest practical degree of reliability.

In order to meet this responsibility, the modern power plant needs dependable motors of many sizes and types to drive an ever increasing number of station auxiliaries. Not only are more motors used today, but the trend is toward larger motors, higher speeds, and greater reliability.

The power station's ability to produce an uninterrupted supply of power depends, among other things, on the ability of essential auxiliaries to function continuously. Simplicity of design and reliability of construction are paramount considerations in selecting motor drives for such equipment. Other important considerations include initial cost, maintenance expense, and economy of operation.

Reliability of operation is primarily obtained by the use of motors having the proper operating characteristics for the auxiliaries involved; and the selection of motors that are soundly designed and engineered for the particular job.

Few phases of power plant design have received so much attention in the technical literature as the one concerned with the selection of electric motors for driving power station auxiliaries. This fact, however, only belies the importance of the subject and so, even at the risk of some repetition, we are pleased to announce this series of three articles on the subject by Mr. Beardmore of the General Electric Co. In earlier days, the selection of motors for auxiliary drive was often haphazard; there was not an adequate understanding either of the load characteristics or of motor characteristics and motors were selected more on the basis of expediency than on sound engineering knowledge. Furthermore, motors with the proper characteristics were not always available. Today, however, conditions are different. Not only is there full and complete knowledge of load and motor characteristics but with modern unit plant design it is highly important that motors driving auxiliaries be specifically adapted to the loads they drive. In many instances the operation of the entire plant is dependent on a single auxiliary and every possible precaution has to be taken to keep such a machine running. The first step in that direction, obviously, is the selection of the proper motor.

In this first article of the series, Mr. Beardmore discusses the fundamental factors involved in the selection of motors for driving power plant auxiliaries. This will be followed by a second article covering motors for stokers, pulverizers and coal handling equipment and, finally, there will be a third one, dealing with fan and pump drives.

Motor Selection

When selecting a motor for any particular job its enclosure should be determined by the ambient conditions in which the motor is to operate, since the function of the enclosure is to protect the winding so that the motor can continue to operate successfully. The more severe the operating conditions, the better the enclosure must protect the windings and bearings. In the newer plants, a drip-proof, 40 C rise motor may be used successfully for nearly all of the essential auxiliaries.

There are many other types of enclosures available for use in bad locations, but in general practice the drip-proof, 40 C rise motor operates successfully in a large majority of the operating conditions found in modern plants. There is no reason why other types of enclosures should not be used in conditions which justify their use.

Where splashing water conditions are extremely bad, splash-proof motors designed for such conditions should be used. These motors are sometimes used to provide protection because the area around the motor, including the floor, is washed with a hose. In some cases, they are used to provide protection against emergency conditions, such as might occur from bad leaks developing in the piping over and around the motor.

For applications where dirt conditions are extremely bad, such as where coal or ash handling equipment is involved, totally-enclosed, fan-cooled motors may be used to good advantage. This type of motor is so thoroughly protected against dirt and moisture that it is seldom necessary to remove it from service to clean it.

If the motors for driving fans are installed directly over the boilers it may be well to check the ambient temperature, because in many cases where the fans are directly over the boilers and motor room ventilation is restricted, the ambient temperature may be 40 C or higher nearly all the time and may even be 50 C or higher during the summer months.

There are several alternatives which may be used successfully in such places. One is to use a motor of a rating slightly in excess of the maximum load which it is to carry, so that the maximum total temperature will not exceed 90 C. Another alternative is to use a motor of a rating corresponding to load requirements and provided with class B insulation, in which case the maximum total temperature should not exceed 110 C. A third alternative is to use a pipe-ventilated motor with the ventilating system arranged to bring clean, cool, air from an external source.

Ventilated motors arranged to discharge the air outside of the motor room are used in some cases where it is desirable to remove the heat of the motor from the motor room.

For locations such as boiler feed pump drive, where ambient conditions may be bad and it is not desirable to have the warm air from the motor discharge into the room, yet the location of the motor makes it inconvenient to use the pipe-ventilated type of motor, base-ventilated motors with a heat exchanger mounted under the motors may be used. With this arrangement, the warm air discharged from the motor passes down through the heat exchanger, is cooled, and is then recirculated through the motor. This provides a closed ventilating system similar to that used with turbine generators. Where conditions will not permit the location of the heat exchanger under the motor, it can be built into the sides of the motor frame, as shown in Fig. 1. This construction provides the motor and heat exchangers built as a single unit, requiring a minimum amount of construction work to accommodate the motor and coolers.

These totally-enclosed motors with surface air coolers are so tightly enclosed that the stator winding is completely protected against even very bad ambient conditions. This construction, including the use of heat exchangers, is usually limited to large motors beyond the sizes where enclosed, fan-cooled motors are available. In a power station such construction is usually, though not necessarily, limited to boiler feed pump drives or condensate pump drives. Where heat exchangers are used, it is possible to use the condensate for cooling the motor and thus the heat losses of the motor are taken back into the system. In some instances, it may be necessary to use some additional cooling during the mid-summer months, when the condensate temperature may be high.

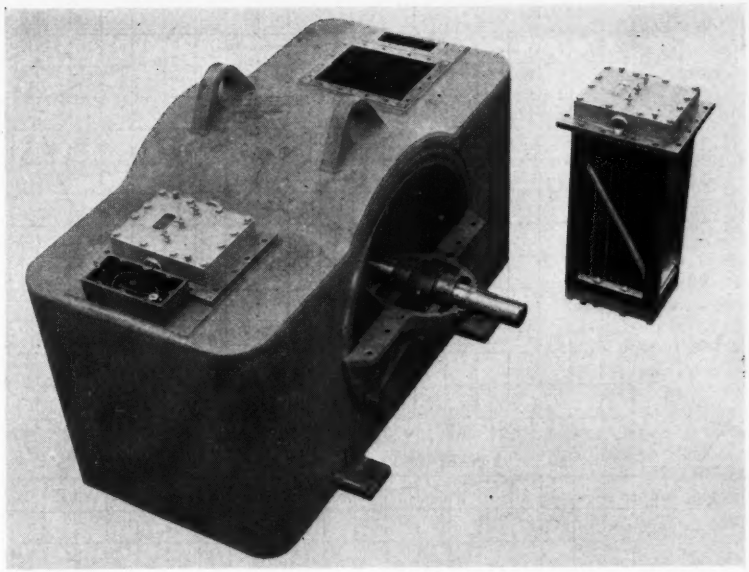


Fig. 1. Enclosed self-ventilated, sleeve-bearing, squirrel-cage induction motor with closed ventilating system and surface air cooler

Since practically all of the major auxiliaries in a power station are essential in that even a momentary failure of any of these auxiliaries is likely to necessitate appreciably reducing the load or taking the turbine generator off the line, it is important that the motors be carefully selected. It is important that the total temperature of the insulation does not exceed the allowable limit for the class of insulation used for any appreciable percentage of the hours in the year, in order to obtain reasonable insulation life which will contribute to continuity of station operation.

Ambient Temperature

The ambient temperature in which a motor operates may have a decided effect on the temperature rating of the motor. Normally 40 C rise, class A insulated motors are applied on the basis of carrying rated load continuously in a 40 C ambient, but they may be designed to carry 115 per cent of rated load with a higher temperature rise. If these motors are not overloaded, they can be used continuously in a 50 C ambient. If the ambient temperature exceeds 40 C for a relatively few hours per year, the effect on the insulation is negligible even at 115 per cent load.

If a motor is operated continuously with the insulation at a total observable temperature in excess of 95 C, the high temperature will tend to shorten the life of the motor winding where class A insulation is used. In general, it should be kept in mind that all increase in total temperature of the insulation over 95 C tends to reduce the insulation life appreciably.

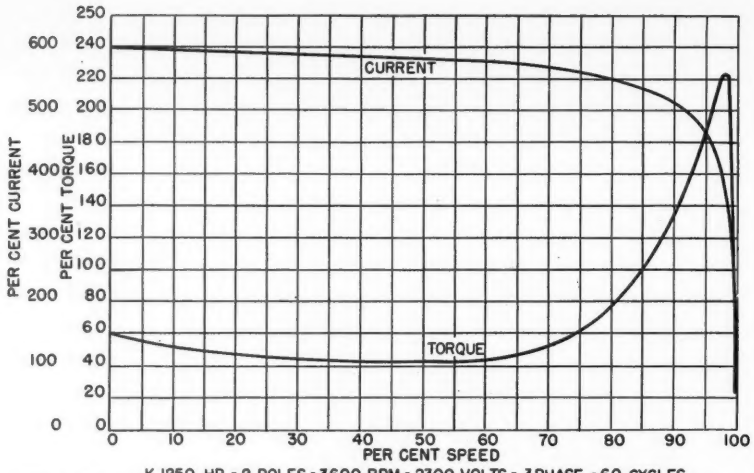
If a combination of load on the motor and ambient temperature is such as to run the insulation temperature up to 90 C or above for a fair percentage of the time, class B insulation should be used, or provision should be made to supply cool air to the motor.

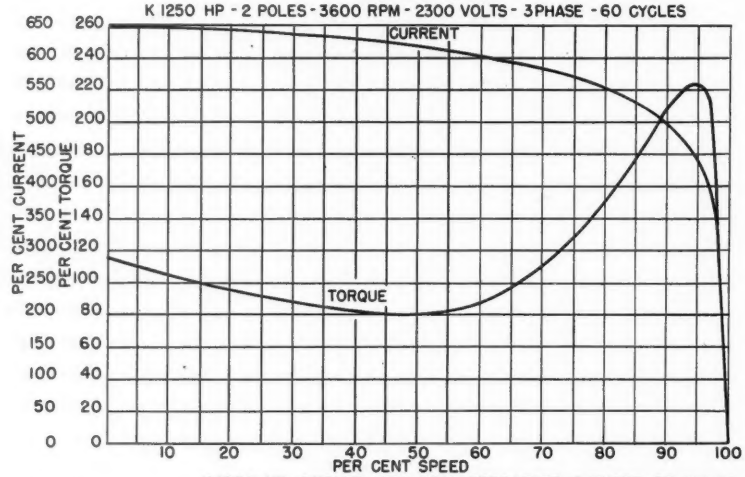
Class B insulated open motors may be rated 40 C rise in a 60 C ambient for continuous operation, and can carry 15 per cent overload continuously in a 60 C ambient with a higher temperature rise.

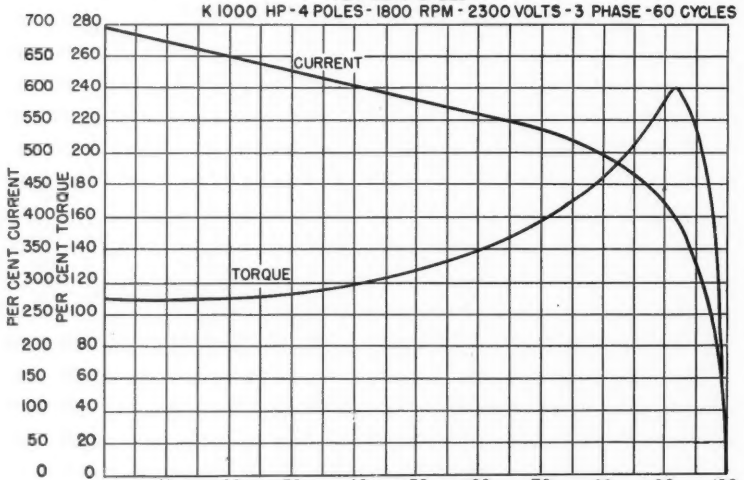
Where fan-cooled motors with class A insulation are used, they are usually specially rated 40 C rise in a 40 C ambient, while class B, insulated, fan-cooled motors are rated 40 C rise in a 60 C ambient. Either of these combinations provides a service factor of 15 per cent, so that as far as motor application from the load standpoint is concerned the fan-cooled motor may be used the same as an open motor. The fan-cooled motor is more expensive, but the additional protection may reduce maintenance cost sufficiently to warrant the higher first cost, since the fan-cooled motors do not require as frequent periodic cleaning as motors with a lesser degree of enclosure. If a service factor is not required and the load conditions are accurately known, a 55 C rise, class A insulated normal fan-cooled motor may be used in a 40 C ambient. Such a combination is actually used for some power station applications at the present time.

Importance of Inertia

The WR^2 of the driven equipment may have an important bearing on the motor to be selected for a power station drive. The WR^2 of a normal power station fan usually is within the limits which a squirrel-cage motor can accelerate successfully. However, recently there have been some cases where the WR^2 of the fans is so high that it is necessary to design a special rotor for squirrel-cage motors to be used for driving these fans. It is






CURRENT
TORQUE
PER CENT CURRENT
PER CENT TORQUE
PER CENT SPEED
FOR TYPE K SQUIRREL CAGE INDUCTION MOTORS 250 TO 1000 HP HAVING 4 OR MORE POLES

Figs. 2 top, 3 center, 4 lower. Typical speed-torque and speed-current curves

usually the induced draft fans that have the high WR^2, since they are usually of heavier construction because of the necessity of resisting erosion caused by the ash carried in the exhaust gas. If an induced draft fan is of unusually heavy construction, the WR^2 of the fan should be made available to the engineer responsible for selecting the type of squirrel-cage motor for driving the fans. If a wound rotor motor is used for driving the fan, the WR^2 of the fan is of little importance since in such cases an increased WR^2 usually will not mean any more than an increase in the time of acceleration.

If synchronous motors are used for driving direct-connected fans, it is essential that the WR^2 be known in every case as the motor must be designed to synchronize the WR^2 of the fan while carrying full fan load. However, very few synchronous motors are being used for direct connection to fans in power stations. Either magnetic or hydraulic couplings are usually used between synchronous motors and the fans which they drive. If couplings are used, suitable control should be provided to unload the synchronous motor if it falls out of step, and keep it unloaded until it has had a chance to resynchronize, after which the load may be reapplied through the coupling.

The WR^2, effective at the motor shaft, of some pulverizers is so high that squirrel-cage motors having special rotors may be required to drive them successfully. In applying squirrel-cage motors to such pulverizers, the engineer making the application should check the WR^2 of the pulverizer with the motor designer to insure that the proper motor is applied.

While are engineers designing and building power stations are in a position to draw on the entire electrical industry for any or all types of electric motors, regardless of price or other possible limitations, they have in most cases actually used only a few of the more common types of motors for major central station drives. The types most commonly used are the single- or multi-speed, normal starting torque, squirrel-cage induction motors; the single-speed, high torque, low slip squirrel-cage induction motors; and the adjustable, variable speed or wound-rotor induction motors. A few power stations use d-c motors for driving the main auxiliaries, and in some cases the commutator type of a-c motor has been used for stoker drive.

Current and Torque Characteristics

The following speed torque and speed current curves are intended merely to give a general idea of their shape, rather than to show the actual characteristics for any particular motor rating. Fig. 2 is a typical speed torque and speed current curve of a large 2-pole, normal starting torque, 3600-rpm, squirrel-cage induction motor. It should be noted that the values of starting torque vary quite widely with the horsepower rating of the motor, i.e., the starting torque of 2-pole motors less than 200 hp may be in the order of 125 per cent of normal full load torque, while in the large high-speed motors the starting torque may be as low as 50 per cent of normal full load torque. In general, the shape of the curve is quite similar, with the low point of the torque curve occurring at about ⅔ speed. In any case, the maximum running or pull out

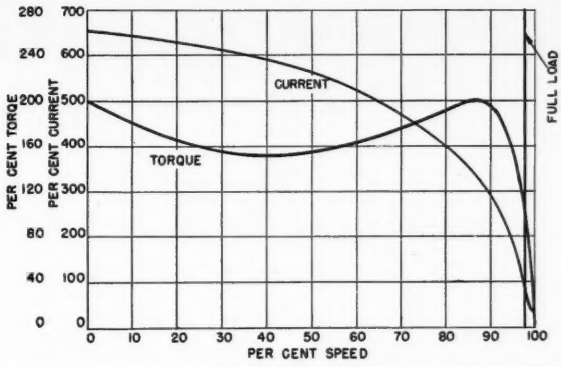


Fig. 5. Typical high starting torque induction motor curves

torque is not less than 200 per cent of normal full load torque.

Figure 3 shows similar typical speed torque and speed current curves for a large, single-speed normal starting torque squirrel-cage induction motor having four or more poles. Fig. 4 shows a similar curve for motors in the range of 250 to 1000 hp having four or more poles. In both cases, the curves are intended merely to show the general shape of speed torque and speed current curves, not the actual values for any particular rating. This is because the value of starting torque changes with the hp and speed of the motor, so that for any particular rating the value of starting torque should be obtained from the motor manufacturer.

In the case of multi-speed squirrel-cage motors, the speed torque and speed current curves for the high-speed will in general be quite similar in appearance to those shown in Fig. 4. There will, however, be more variation in the curves of multi-speed motors, particularly for the low speed, since it is sometimes necessary to modify the characteristics of one speed in order to obtain more suitable or desirable characteristics at the other speed.

Figure 5 shows the typical speed torque and speed current curves of a high starting torque squirrel-cage induction motor such as is used for pulverizer drives. These motors usually have at least 200 per cent starting torque and 200 per cent maximum breakdown or running torque, with a general shape of the curves as shown.

Figure 6 shows in general the speed torque and speed current characteristics of a wound-rotor motor with the slip rings short-circuited. Note that the curves are not carried down to zero speed, as wound-rotor motors are not intended to be started from rest with the rings short-circuited. Wound-rotor motors are normally used with an external secondary resistance which is connected to the rotor winding by means of brushes that ride on three slip rings on the rotor. It is possible to change the starting torque and starting current of wound-rotor motors by changing the amount of resistance in the secondary. In general, the starting torque and starting current are very nearly proportional; that is, with the proper adjustment of the secondary resistance, it is possible to obtain 100 per cent starting torque with only slightly over 100 per cent starting current, and, likewise, 150 per cent starting torque with slightly over 150 per cent starting current.

The starting current of wound-rotor induction motor is determined by the amount of resistances in the secondary circuit. Full voltage is applied to the primary winding by closing the line breaker or contactor. The starting currents, starting torque, and the operating speeds are controlled by the amount of resistance in the secondary circuit. By inserting sufficient resistance in the secondary circuit, it is possible to keep the initial current inrush, and consequently the starting torque, at a value less than full load current and torque, respectively.

Suggested Voltage Limits

In order to obtain maximum life and continuity of service for power station auxiliary motors, it is recognized that an attempt should not be made to build the smallest possible horsepower at the maximum possible voltage for each speed and hp combination. This is because a low hp rating built at high voltage necessarily means that the size of the conductors in the motor winding are reduced to a minimum, with a consequent reduction in mechanical strength and therefore in reliability of the motor. While it is recognized that smaller hp ratings are available at the various voltages, the following tabulation gives the minimum hp considered by many to be good engineering practice, from the motor

(Continued on page 80)

7000 volts, 300 hp and larger at 3600 rpm
250 hp and larger at 1800 to 600 rpm, incl.
5000 volts, 200 hp and larger at 3600 rpm
150 hp and larger at 1800 rpm to 600 rpm, incl.
4200 volts, 100 hp and larger at 3600 rpm
75 hp and larger at 1800 rpm
50 hp and larger at 1200 rpm to 600 rpm, incl.
3000 volts, 60 hp and larger at 3600 rpm
40 hp and larger at 1800 rpm
30 hp and larger at 1200 rpm to 900 rpm
40 hp and larger at 720 and 600 rpm
440-550 volts, ½ hp to 100 hp at any speed
200 volts to 600 volts, 1 hp to 200 hp at any speed
110 volts, ½ hp to 5 hp at any speed
115 or 230 volts, single phase, fractional hp at any speed

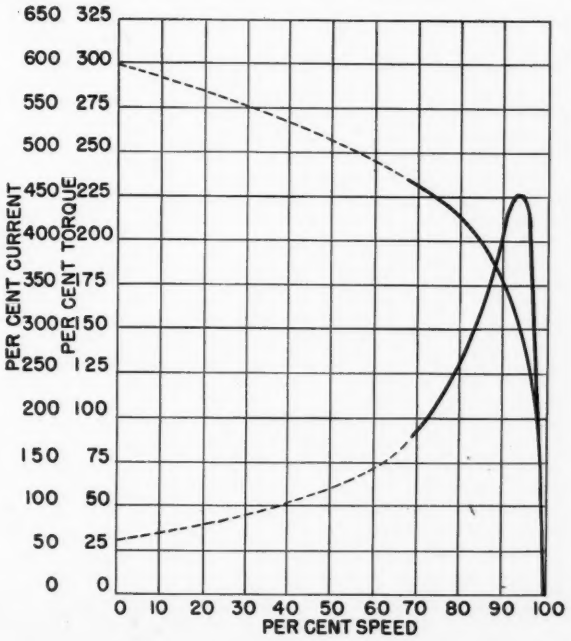


Fig. 6. Speed-torque and speed current curves of a wound rotor motor with rings short circuited

Functions of an Efficiency Bureau*

By JOHN R. MICHEL

Mechanical Assistant to Superintendent, Generating Stations, Commonwealth Edison Co., Chicago

Organization chart of the Commonwealth Edison Co. Efficiency Bureau —Procedure for advancement of employes through operating duties to executive positions—Monthly summaries of station performance prepared by Bureau—Equipment performance constantly checked—Replacement and alterations studied and proposals passed upon—Library maintained and statistics gathered—Heat balances checked against performance of stations and operating manuals prepared

FOUR STEAM electric generating stations in Chicago, ranging in capacity from 187,500 kw to 437,500 kw, operate with throttle steam conditions up to 1250 psi, 925 F. Power plant equipment in these stations could well constitute a panorama of generating station development, since Fisk Station, the earliest of the four, was the first large all turbine power station in America. Many firsts were included in the development of the stations and it is with the performance of the stations and station equipment, and with the practical or applied research and study concerning development that the Efficiency Bureau of the Operating Department works.

Shown in the diagram is the organization of the Department. It will be noted that the Efficiency Bureau reports as staff to the Superintendent of Generating Stations. The group is comprised of a relatively small number of men in normal times consisting of some eight or ten reporting through supervisors to the Superintendent. The supervisors started in the efficiency group, progressed through station supervisory operating positions and were advanced to their present positions. All in the group are engineering graduates. Two men have remained in the group a considerable length of time and they coordinate and guide the actual testing work of the younger men. The engineering graduates start as Engineers, Junior Grade, and as they learn to apply their theory to practical power plant problems, they assist in performance tests of auxiliary equipment and later take more and more important parts in testing and analyzing the performance of major equipment.

Thus they become generally familiar with the stations of the system from the coal plants through the boiler plants, turbine rooms and the stations' electrical and maintenance divisions. The experience gained from testing work, analysis of performance difficulties, determination of station performance and preparation of operating manuals and operating procedures, in a relatively few years prepares them for operating positions. The Efficiency Bureau as we know it today was organized in 1921.

*Paper presented at ASME Panel Discussion on Reducing Losses in Power Generation and Consumption, Annual Meeting, New York.

Training for Supervisory Positions

Aside from the regular work performed, the Efficiency Bureau has rendered a real service in preparing men for supervisory operating positions. The present Chief Engineers in each of the stations at some time worked in the efficiency group and this is true also of a large percentage of other operating supervisors, especially those engaged in the station turbine and steam generating divisions. In the discharge of their responsibilities these supervisors constantly use the training received in the efficiency group.

While it is true that the training received has benefited those who started in the efficiency group and has improved the performance and speeded the advancement of those who have progressed from it to operating positions, it is also true that many excellent supervisors progressed from operating employee classifications. All employees are urged to participate in and benefit from outside study courses which apply to their work. Those starting in operating positions who complete sufficient studies to fulfill the requirements for Efficiency Bureau work are frequently transferred to that division so they may benefit from its training.

This inter-change of men in operating and testing positions has been of real advantage to all concerned and has resulted in a spirit of cooperation between operating and testing groups that is excellent. The present difficulty is to satisfy the requests of operating supervisors for test services and aid in the analysis of problems that require special instrumentation facilities and man power for special analysis.

Summaries of Station Performance

The group prepares monthly summaries of station performance as one of its regular duties. These are detailed analyses setting forth the month's performance of each piece of station equipment that to any appreciable degree affects the overall performance of the station. The reports are submitted to the Superintendent of Generating Stations who, after approving them, sends them to the supervisors concerned. Deviations from desired performance are set forth and where necessary, corrective measures are instigated by the Superintendent or by the operating supervisors.

Equipment performance which requires frequent or daily checking is accomplished through field checks the procedures for which are set up by the testing group. These include checks depending on periodic or day-to-day observations in operation or data drawn from log readings. They are assembled in the form of charts or tabulations by the operating personnel who are guided in their procedure by the indications.

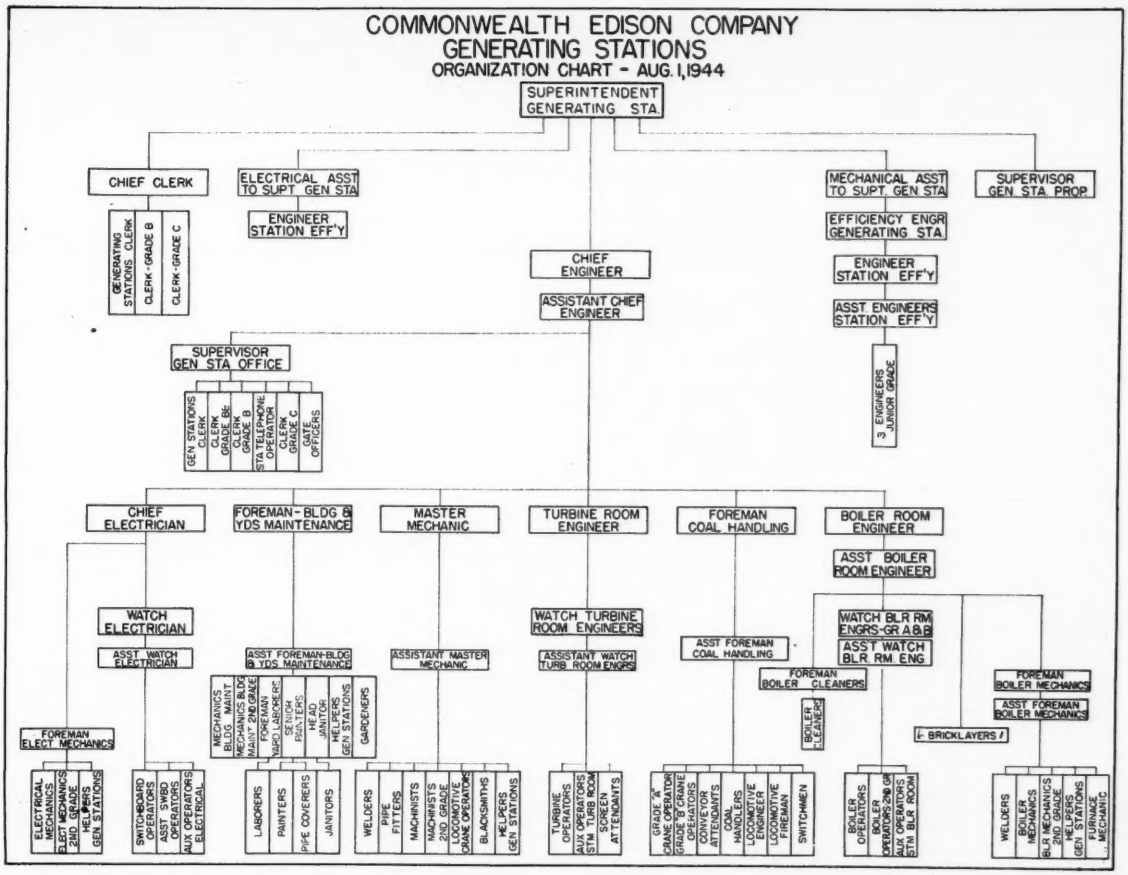
The testing of plant equipment which requires the collection of a considerable amount of precise data such as in heat rating a turbine or a plant section, is performed by the efficiency group. The results of the tests are calculated and assembled in the form of reports. These indicate the results of repairs or changes and are sent to those concerned by the Superintendent. In many cases the operators in cooperating with the testing group are aware of the results before the report is issued.

Statistical studies and engineering investigations of present equipment or operating conditions and studies of the effects of proposed or suggested changes in any items of steam generating equipment are subjects that receive attention. Proposed replacements or alterations are carefully studied to determine the resulting effects on investment, operating costs, and performance. Worthwhile projects are initiated and tentative designs are made for the Engineering Department for those installations or rearrangements that are commercially desirable.

Proposed Improvements Investigated

Major items involving process, such as chlorination of circulating water, application of overfire air to chain grate stoker firing, application of regenerative feedwater heating, gas firing, and operation with washed coal, are studies involving pilot plant operation which have been conducted by the efficiency group. An important investigation which required the installation of a complete boiler for test purposes is under way at present. Many of the investigations have resulted in developments affecting methods of operation and plant design or major plant changes. In many cases considerable economy has resulted.

Not of the least importance is the library of Efficiency Bureau reports. These form a reference of develop-



ment, history and statistics. They are referred to repeatedly in connection with current problems with the equipment under study. These reports now numbering some 1500 cover nearly all subjects of power plant operation from coal sampling through the incremental loading of the units of the system. They have proved to be of a value far exceeding the cost and trouble of formal preparation.

When new installations or major plant additions are considered the heat balances are checked. These chacks are submitted to the Superintendent for use in determining proposed design. Before the installation of new units is completed, instruction books are prepared. These contain descriptions of the new equipment, equipment performance guarantees, sectional drawings of equipment with pertinent dimensions and detailed operating procedures. Some of these operating manuals contain 150 printed pages and 75 sectional drawings. After preparation of the manual and before operation of the new equipment, classes are held for the operators. Instructors for these classes are drawn from the supervisory operators who will be responsible for the operation of the equipments. After the unit is in operation, performance tests are conducted by the efficiency group to determine whether the included equipment and the unit as a whole has met its design guarantees.

Line Responsibility Maintained

Throughout the Generating Stations Department organization, line responsibility for operation, maintenance, and performance has been maintained. The activities of the efficiency group are of a staff nature. This has proved adequate over the past twenty-five years for checking performance, trouble shooting, starting new equipment in operation, accomplishing the practical research required for process development and for the training of personnel for responsible operating positions. Evidence of the effectiveness of this type of organization is indicated by those contributions it has made toward reducing the combined average heat rate of the stations some 10,000 Btu per kw over the past twenty-five years and by the results of investigations which have contributed to designs used by ourselves and associated companies.

A Telemeter Without Commutator

A ROBOT, commonly called a telemeter, reposes quietly in some isolated part of a power system, counting the kilowatts at that spot. It sends in the sum as a set of impulses to some common point where perhaps it is totalized with the reports of similar instruments. This telemeter has heretofore consisted of a commutator driven at a speed proportional to the quantity being measured. The rate of interruptions or pulses produced by the commutator is the transmitted indication of that quantity. But brushes drag on a commutator with varying amounts of pull. As the speed decreases, the drag becomes more pronounced and again this braking action is different with one direction of rotation than it is with the other.

A photoelectric scheme developed by Westinghouse removes troubles from the telemeter transmitter. Two discs with holes are rotated, one at constant, fixed speed, the other at a speed proportional to the quantity measured and in a direction depending on the direction of power flow. A lamp shines upon the rotating discs, casting light, when the holes are coincident, on a photoelectric tube on the other side. The result is a series of light impulses that are noted by the phototube, amplified, and transmitted. As the metering disc changes in speed or direction due to fluctuations or reversals in the flow of power, the number of pulses transmitted change accordingly. If no power is being transmitted, light impulses of the standard or base rate are produced. The resulting signal can thus be interpreted both as to direction and magnitude of the power flowing.

Allen Latham, Jr. *Arthur D. Little, Inc., Cambridge, Mass.*

Explains How to Produce Pure Water By

Compression Distillation

New process, low fuel consumption . . . 175 lb of distilled water from sea water per pound of fuel consumed . . . Developed for military uses during war by Commodore R. V. Kleinschmidt . . . Steam from still is compressed mechanically, raising its temperature so it can in turn boil raw water . . . No cooling water needed . . . Influence of scale formation, type of steam compressor, adaptability to various prime movers discussed . . . Application to industrial processes for distillation and evaporation

POSSIBILITY of attaining unusually high fuel economy in distillation by using the compression method has been recognized for many years, but not until World War II was this method widely used. Fundamentally the high fuel economy of this process depends upon compression of the vapor leaving the evaporation compartment so that it can be used in the steam chest in place of process steam. The most recently developed units for distillation of sea water are capable of producing 175 lb of distilled water for each pound of fuel consumed. This represents what is believed to be the highest fuel economy of any practical system of evaporation, with the exception of solar evaporators and systems which are tied into other plant operations, as in the case of a "reducing valve evaporator."

It appears likely that there is a much broader field of practical application for compression distillation than in the production of distilled water.

Principles of Compression Distillation

Figure 1 is a diagrammatic representation of this process as applied to the production of fresh water from sea water. Normal operation is preceded by a period of heating to bring the apparatus and its contents to operating temperature. As soon as the evaporator has been filled with steam, the still may be turned on stream for continuous operation. The sea water feed enters by way of a triple-passage liquid-to-liquid heat exchanger, which extracts heat from the outgoing distillate and brine to heat the feed. The feed at about 207 F is then introduced to the evaporator where it mixes in a relatively large volume of brine which circulates by natural circulation through the vertical tubes.

Steam at, or slightly above, atmospheric pressure is led from the eva-

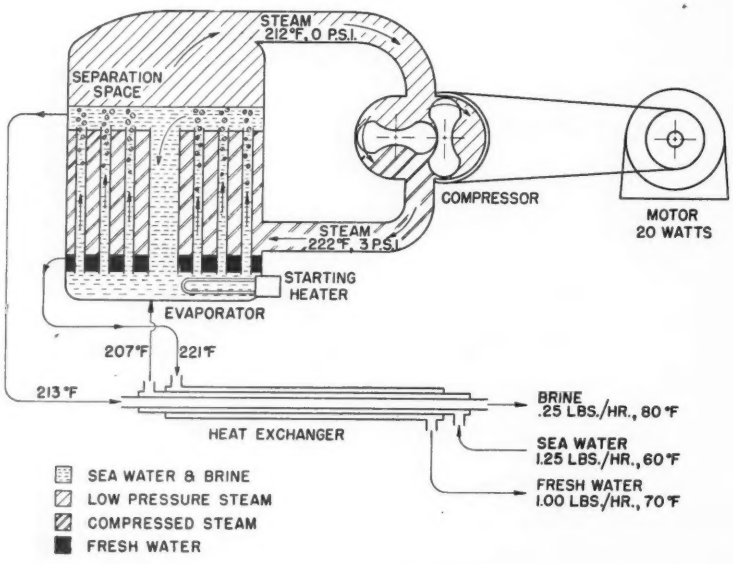


Fig. 1. Diagram of compression distillation as applied to distillation of sea water.

THE INVENTOR

Doctor R. V. Kleinschmidt has been associated with Arthur D. Little, Inc., for many years. Following his service with the Navy, which he is leaving as Commodore Kleinschmidt, USNR, he is again associated with the Little organization. Before the present war, the development of the compression distillation system was initiated in the laboratories of that organization by a group headed by Dr. Kleinschmidt, who was first to advocate mechanical compression distillation for Naval and military uses.

This and subsequent models were manufactured by E. B. Badger & Sons Co., of Boston, under a co-operative arrangement with Arthur D. Little, Inc. There is now enough Kleinschmidt compression distillation equipment in service to produce distilled water for the daily needs of over a million men. Devices and inventions used in the process are covered by patents assigned to Arthur D. Little & Co., Inc. With the war-time needs satisfied, the Kleinschmidt still will be manufactured under license for sale to industry.

The author of this paper, Allen Latham, Jr., directed the wartime development of the method and its modifications to fit a variety of practical needs. This is an abstract of the complete paper he delivered on this subject on November 27, 1945, before the annual meeting of the ASME in New York.

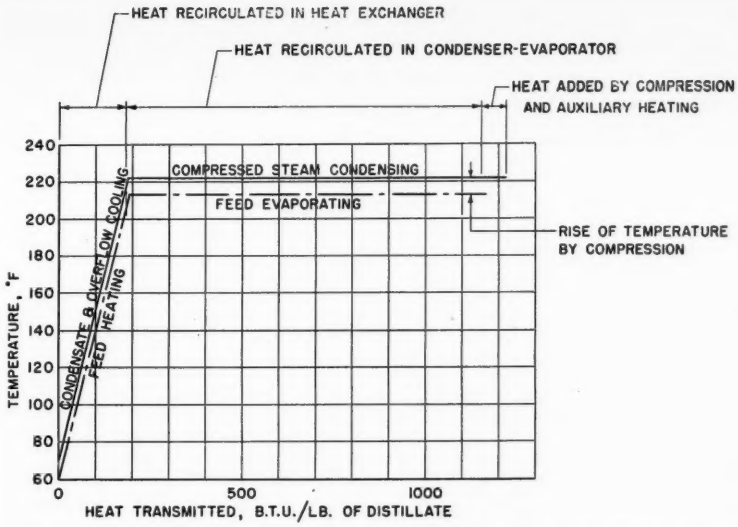


Fig. 2. Temperature—Heat Quantity relationship in compression distillation unit.

poration space through an entrainment separator to the compressor, which raises the pressure to about 3 psi gage, thus raising its saturation temperature to about 222 F. Since the brine in the evaporation space boils at about 213 F, there is a temperature differential of about 9 F between the compressed steam and the boiling brine to permit transfer of heat from the former to the latter. Substantially all of the latent heat of the compressed steam is used in maintaining evaporation in the evaporation space; thus no separate condenser or cooling water is required.

With a unit of 1000 gal per day capacity, the production of 1 lb per hr of distillate requires an electric power expenditure of about 20 watts. To produce the same amount of distillate in a single effect evaporator would require approximately 300 watts. From this it is apparent that the Kleinschmidt compression distillation process as applied to sea water distillation has an economy equivalent to some 15 or more effects.

Furthermore, a compression distillation unit is far more simple to operate than a multiple effect unit. The connections, heat transfer apparatus and controls are as simple as those on a single effect evaporator. Ordinarily, control of the operation is made entirely through adjustment of the flow of feed only. That this process requires very little operational attention is evidenced by the fact that on shop tests, units set up for manual control have been left running day and night for as long as a week without adjustment of any sort.

Details of Heat Relations

Figure 2 is a graphical representation of the relationship between the heat quantities and temperatures throughout the process. Cold feed entering at 60 F is heated (inclined dot dash line) to 207 F by heat exchange with the outgoing condensate and overflow (inclined solid line). Following final heating in the evaporator from 207 F to 213 F, the hot feed is vaporized (horizontal dot dash line) by heat exchange with the condensing compressed steam (horizontal solid line). At all points in the process a suitable temperature differential exists to permit the exchange of heat from the condensate and overflow for preheating the feed and from the condensing compressed steam for evaporating the feed. The temperature differentials indicated are 10 F in the heat exchanger and 9 F in the condenser - evaporator. The diagram shows an excess of heat on the high temperature side (right hand end of horizontal solid line) which allows for heat loss from the process to the surroundings through the insulation and for an operating margin. For instance, the operation of the process may be stabilized by allowing a portion of this excess heat to pass from the process, automatically venting a small amount of steam to the atmosphere. For this purpose the low pressure steam separating space is often connected to the atmosphere through a breather vent. As indicated by the diagram, which is based on a capacity of 1000 gals per day, the total excess heat allowed for insulation losses and stabilization losses may be of the order of 55 Btu per pound of distillate. It may be noted also that by adding 68 Btu to the process at the compressor, not only is this excess supplied, but also a temperature differential of 9 F is created for operation of the condenser-evaporator. In this manner heat is recirculated to the extent of 960 Btu in the condenser-evaporator, and 190 Btu in the heat exchanger. Thus, the 68 Btu added at the compressor serves to circulate a total of 1160 Btu per pound of distillate, as well as supplying a surplus of heat for operational leeway.

For this cycle where all-electric drive is used, the efficiency of the steam compressor need not be high. The amount of energy required for this compression ideally would be only about 15 Btu compared with the 68 Btu which on moderate sized units has been found practical. Actually, the full 68 Btu is not ordinarily added entirely at the compressor. Perhaps 35 Btu is put in at this point and the rest is added by use of electric heaters in the evaporation zone.

Effect of Scale Formation

As in many evaporation processes, the compression distillation process is usually affected by scale formation on the evaporation surface. In some ways the effect of scale formation on the performance of a compression evaporator is more noticeable than on more conventional types. The added resistance to heat transfer produced by scale requires an increase in compressed steam pressure in order to maintain constant output. This results in more energy entering the system by way of the compressor.

In an all-electric drive, the added energy input from the compressor may be compensated for by a decreased use of the electric heater, thereby maintaining a practically constant total electrical input regardless of scale formation.

A rather different situation exists in the case of an internal-combustion-engine drive equipped for waste heat recovery. In this case, the waste heat is more than sufficient to perform the same function as the electric heaters in an electric drive. Scale formation leads to a heavier load on the engine, which in turn gives up more waste heat, which of course is not needed for operational leeway. Thus the engine-driven unit has a characteristic of low fuel consumption when the evaporator is clean, and gradually increasing fuel consumption as scale formation progresses. In spite of this, however, the overall economy of the engine drive is difficult to surpass with any other drive.

Performance of Unit

Figure 3 shows the field test results of an experimental unit of this type. The evaporator was started clean and operated for a total of 730 hours before being shut down for cleaning. During this time the compressed steam pressure rose from 3.1 psi gage to 5.3 psi gage, an increase of 71 per cent. Corresponding drop in product to fuel ratio was 185 to 122, or 34 per cent. For this same period the

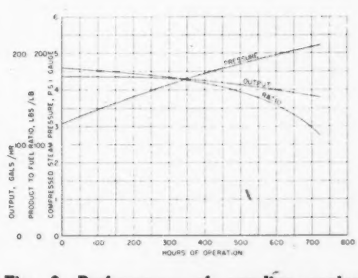


Fig. 3. Performance of gasoline - engine driven compression distillation unit.

capacity dropped from 169 to 152 gals per hr, or only 10 per cent.

Under the above discussion of the effect of scale formation, the fact that the economy of the compression unit is somewhat governed by the compressed vapor pressure is noted. A broader exposition of this relationship is presented in Fig. 4 for the purpose of more fully defining the limits of application of the compression principle. These calculations are based on thermodynamic properties of steam. Similar relationships, of course, could be calculated for other vapors. Temperature differential rather than pressure differential is used as the criterion because the resultant curve applies over a broader range of conditions.

For instance, if the evaporator pressure is held at 10 psi gage instead of 0 psi gage, the theoretical energy requirement for maintaining 10 F differential between the condenser and evaporator will be practically unaffected, whereas the pressure differential will increase some 65 per cent. For purposes of calculation, the efficiency of the steam compressor is assumed as 75 per cent on an adiabatic basis. The denominator of the ratio "energy recirculated over energy input" is the energy delivered to the compressor shaft expressed in heat units.

In practical applications, a wide variety of prime movers or drives for the compressor may be used, and since these cover a wide range of thermal efficiencies, the overall ratio of heat recirculated to heat input must be calculated for each individual application. With further reference to Figure 4, it is pertinent to note that most compression distillation equipment developed thus far has been in capacities less than 250 gals per hr. In such a unit, the amount of heat required for insulation losses and allowance for operability has been the governing factor in determining the heat input.

This means that these units operate at points well to the left of the curve in Fig. 4, about at the intersection of the 10-deg differential line with the 15 ratio line. With large units and conditions typical of industrial practice, a much closer approach to this curve should be possible. For any particular application, the optimum

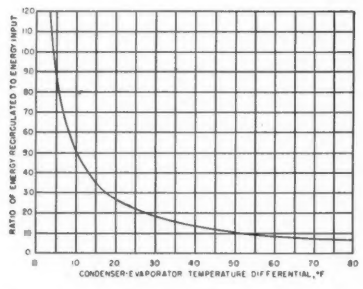


Fig. 4. Calculated performance of compression distillation process.

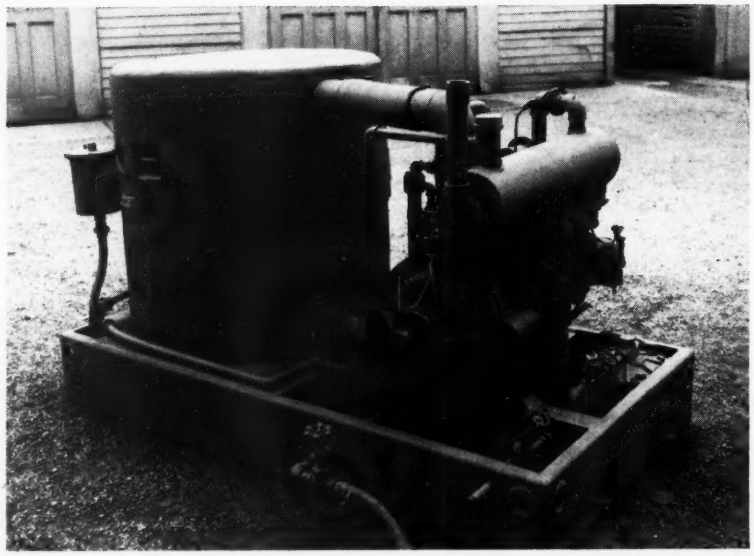


Fig. 5. Recent compression distillation unit, gasoline engine driven, produces 1800 gal distilled water per day from sea water.

design may be determined only after careful consideration of a great variety of factors, such as the relationship represented by Fig. 4, the cost of heat transfer surface, the cost of insulation, the cost of power and the limitations of available steam compressors.

Right Compressor Important

Progress in development of compression distillation has always been hindered by lack of suitable compression equipment. Development of compression equipment for this purpose is still by no means complete. Ordinarily, the high quality standards for the distillate rule out the use of any lubricant in the compression space. In fact, this requirement not only makes it impossible to use the most readily available types of compression equipment, but also requires that whatever equipment is used must be specially fitted with seals to prevent the passage of lubricating oil from the working parts into the compression space.

Furthermore, the gradual rise in pressure caused by scale conflicts with the basic characteristics of centrifugal and axial flow compressors, so that if these types of compressors are to be used, some means of frequently removing scale or of compensating for the pressure rise would be necessary. Thus the choice for many applications is narrowed down to positive displacement compressors which operate without oil in the compression space.

Possibly the Connersville type blower is the best known of the types which fall within these requirements. In fact a great many Connersville machines are being used in this service today. However, for distillate production of over 300 gals per hr per unit, the Connersville type of machine does not show promise of being readily adaptable. Current development of improved types of compressors may make a wider choice of satisfactory compression equipment possible in the near future.

Today, the status of the compression distillation art is sufficiently advanced to justify its recognition as a radically new factor in the field of distillation and evaporation.

Application of Electric Motors to Power Station Auxiliaries

(Continued from page 75)

standpoint, for general purpose applications of 3-phase, 60-cycle motors.

Even though it is possible to build the minimum hp at the various voltages, as shown above, it is not desirable to use the minimum hp which it is possible to build at any given voltage for applications where reliability is paramount.

Good engineering usage in power stations indicates that 2300 volts should not be used for motors smaller than 100 hp, and that 4000 volts should not be used for motors smaller than 200 hp at any speed normally used for power station auxiliaries.

Good engineering practice also dictates that motors up to and including 300 or 350 hp be operated on 440 or 550 volts. Usually, motors 300 hp or 350 hp and larger are operated on 2300 or 4000 volts.

After having considered the characteristics of motors and the enclosures required to protect them, attention can now be given to the types of motors to be used for the different types of equipment in a power station.

(To be continued)

ATOMICS

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

THE DEVELOPMENT OF ATOMIC ENERGY

This is the fifth and last of a series of articles giving a general account of the development of methods of using atomic energy for military purposes under the auspices of the United States Government. This article discusses the final phase, that involving the design and construction of the atomic bomb itself. These articles are based upon the official report by H. D. Smyth, Chairman of the Department of Physics of Princeton University.

By Andrew W. Kramer ***Managing Editor, Power Plant Engineering***

THE FOUR ARTICLES that have preceded this one have described in considerable detail the various methods used for producing the two materials which could be used in the construction of an atomic bomb based upon the principle of nuclear fission. The development of a self-sustaining nuclear chain reacting pile was an outstanding achievement in itself; one fraught with implications of inestimable importance. Yet the object of this development, as has been pointed out, was not a controlled nuclear fission process but the production of plutonium.

This fact should be kept in mind in our thinking of atomic energy. As Dr. Oppenheimer, who had charge of the atomic bomb research and development laboratories at Los Alamos, has pointed out upon several occasions, people ask how soon, if at all, we will be able to control atomic energy so we can devote it to commercial use. They ask whether the explosive properties of the atomic bomb can be reduced to a gradual controlled flow of power which will save humanity rather than destroy it.

As those who have read the preceding articles know, the facts are almost the reverse of this process of reasoning. The atomic bomb was not a step on the road to the production of controlled atomic energy. The bomb itself was the end result, the solution of a military problem that had been given to the scientists. In coping with that problem they learned how to create and control atomic energy a year and a half before Hiroshima. The control of atomic energy had been established at the University of Chicago when the first self-sustaining nuclear chain reacting pile went into operation in December, 1942. What was necessary was to pass that point. Those in charge of the work had to find ways to make the energy explode. The production of controlled atomic energy was merely a step on the way to that goal.

Experimental study of problems that had to be solved before progress could be made on the design of a bomb were started early in the history of the project. This work went along simultaneously with the work on the production of materials for use in the bomb. By the summer of 1942 these studies had proceeded to a point where it was desirable to expand the work considerably and set up a separate laboratory.

In the choice of a site for this atomic bomb laboratory, the all important considerations were secrecy and safety. It was therefore decided to establish the laboratory in an isolated location and to sever unnecessary connection with the outside world.

By November, 1942, a site had been chosen—at Los Alamos, New Mexico. It was situated on a mesa about 30 miles from Santa Fe. One asset of this site was the availability of considerable area for proving grounds, but initially the only structures on the site consisted of a handful of buildings which once constituted a small boarding school. There were no laboratories, no library, no shop, no adequate power plant. The sole means of approach was a winding mountain road. That the handicaps of the site were overcome to a considerable degree, is a tribute to the unstinting effort of the scientific and military personnel.

J. R. Oppenheimer has been director of the laboratory from the start. He arrived at the site in March, 1943, and was soon joined by groups and individuals from Princeton University, University of Chicago, University of California, University of Wisconsin, University of Minnesota and elsewhere. With the vigorous support of General L. R. Groves, J. B. Conant and others, Oppenheimer continued to gather around him scientists of recognized ability so that the end of 1944 found an extraordinary galaxy of scientific stars gathered on this New Mexican mesa.

Naturally, the task of assembling the necessary apparatus, machines and equipment was an enormous one. Three carloads of apparatus from the Princeton project filled some of the most urgent requirements. A cyclo-

Attention is directed to the diagrams presented in this article showing the possible construction of an atomic bomb. These designs are not based on any information regarding the actual construction of the atomic bombs used by the U. S. Army, they are purely the result of the writer's knowledge of the basic facts contained in the Smyth report and his imagination. No details of the design of the atomic bomb have been released nor is it likely that they will be, but that does not prevent anybody from speculating on the probable bomb design.

This is exactly the point the scientists who worked on the bomb are emphasizing—that, even though we may try to keep the design of the bomb a secret, others will be able to work out an effective design from the basic information contained in the Smyth report, much of which was known prior to 1941. Any intelligent person, mechanically inclined and knowing the basic principles of nuclear fission can sit down with pencil and paper and draw a dozen designs of a bomb, one or more of which might work. All the time constants have not been disclosed, nor has anything detailed been released on the amounts of fissionable material used in the actual bombs but even without this information, enough is known of the general principles involved to enable people trained in science and engineering to work out designs that might be effective.

It must be remembered that most of the work that went into the development of the atomic bomb was spent not on the design of the bomb itself but on methods for producing the material used in the bomb. This work involved the great plants at Oak Ridge and at Pasco, Washington. Most of the money spent went into that part of the work. Once a sufficient amount of U-235 or plutonium had been produced, the construction of the bomb itself was a relatively simple matter. True, it involved an immense amount of study and research but the general pattern of the bomb was reasonably clear. It involved no such astonishingly new conceptions as those contained for example in the development of the cavity magnetron for radar.

Those who feel that we can keep the secrets of the atomic bomb to ourselves will do well to study the diagrams shown on these pages and ask themselves whether their assurance is as well founded as they think it is. A scientist of no less eminence than Dr. Irving Langmuir stated before a Senate investigating committee that Russia could begin production of atomic bombs in three years and that she very likely could turn them out faster than the United States because of her tremendous resources.

tron from Harvard, two Van de Graaf generators from Wisconsin, and a Cockcroft-Walton high-voltage device from Illinois soon arrived. As an illustration of the speed with which the laboratory was set up, it may be recorded that the bottom pole piece of the cyclotron magnet was not laid until April 14, 1943, yet the first experiment was performed early in July.

In the preceding articles the general conditions required to produce a self-sustaining chain reaction were described. It was pointed out that there are four processes competing for neutrons. 1, the capture of neutrons by uranium which results in fission; 2, non-fission capture by uranium; 3, non-fission capture by impurities; and 4, escape of neutrons from the system. In the work already described, these processes had to be used in such a way that the chain-reacting system which resulted would not blow up. In the production of the atomic bomb, however, it was necessary to develop a chain reaction which would blow up.

ATOMICS

By definition, an explosion is a sudden and violent release of a large amount of energy in a small region. To produce an efficient explosion in an atomic bomb, the parts of the bomb must not become appreciably separated before a substantial fraction of the available nuclear energy has been released since expansion leads to increased escape of neutrons from the system and thus to premature termination of the chain reaction. Stated differently, the efficiency of the atomic bomb will depend on the ratio of (a) the speed with which neutrons generated by the first fission get into other nuclei and produce further fission and (b) the speed with which the bomb flies apart. Using known principles of energy generation, temperature and pressure rise and expansion of solids and vapor, it was possible to estimate the order of magnitude of the time interval between the beginning and end of the nuclear chain reaction. Almost all the technical difficulties of the project came from the extraordinary brevity of this time interval.

We have already explained how no self-sustaining chain reaction could be produced in a block of pure uranium metal no matter how large because of parasitic capture of the neutrons by U238 atoms. This conclusion has been borne out by various theoretical calculations and also by direct experiments. For purposes of producing a non-explosive pile, the trick of using a lattice and a moderator suffices by reducing parasitic capture sufficiently. For purposes of producing an explosive unit, however, it turns out that this process is unsatisfactory on two counts. First, the thermal neutron takes so long to act that only a feeble explosion would result. Second, a pile is ordinarily far too big to be transported. It is therefore necessary to cut down parasitic capture by removing the greater part of the U238 or by the use plutonium.

The same factors which govern the critical size of a chain reacting pile such as described in previous articles, governs the size of an atomic bomb. It was evident that the bomb could not use a lattice but would use a homogeneous metal such as U235 or plutonium.

The calculation for the critical size of a homogeneous metal is simpler than for a lattice type of unit, still a great deal of uncertainty regarding this matter of size prevailed during the early course of the work. By the spring of 1943, however, several estimates of critical size had been made using various methods of calculation and using the best available nuclear constants, but the limits of error still remained large.

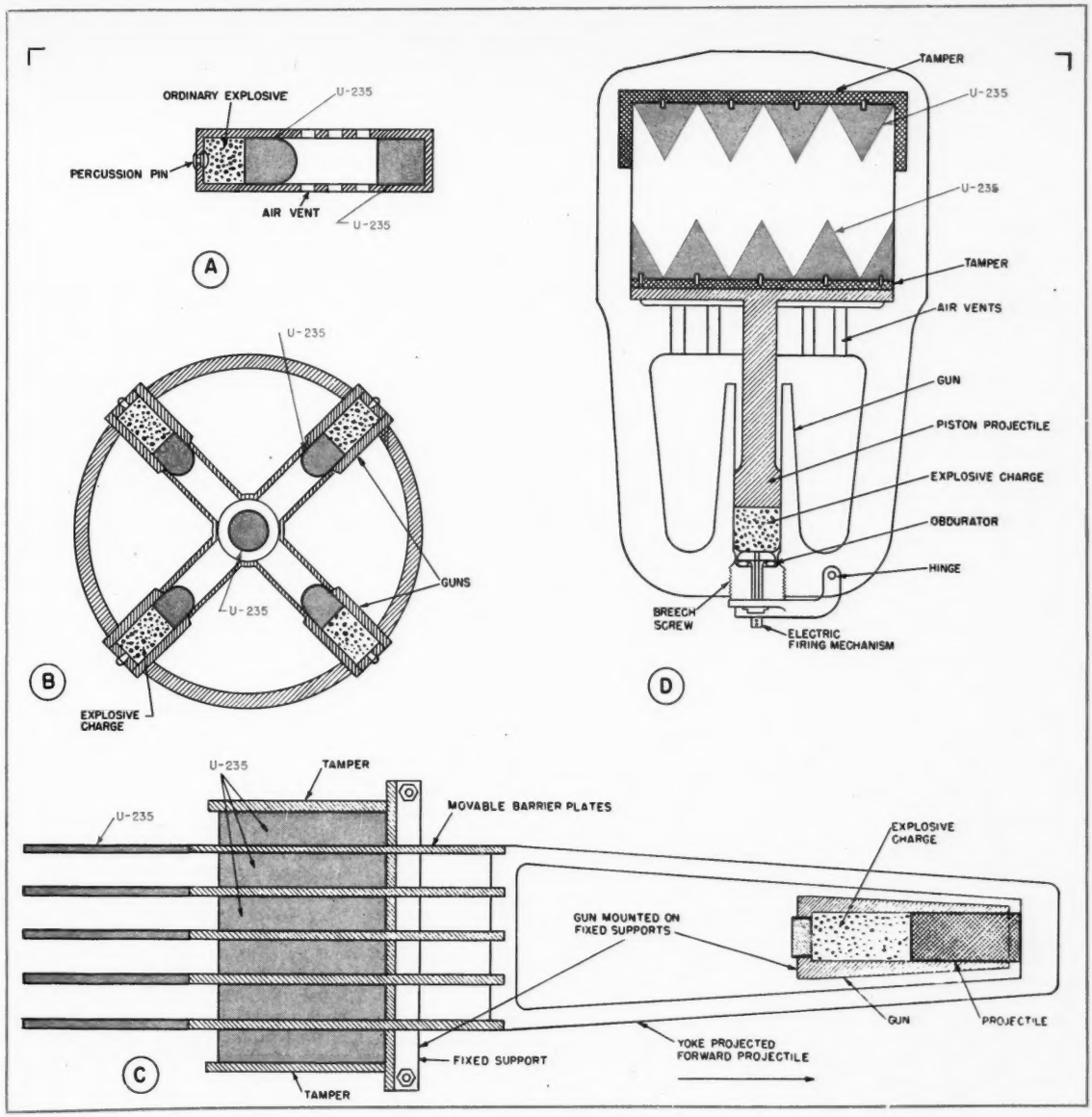
The Reflector or Tamper

In a uranium-graphite, chain-reacting pile, the critical size may be considerably reduced by surrounding the pile with a layer of graphite, since such an envelope reflects many neutrons back into the pile. A similar envelope can be used to reduce the critical size of the bomb, but here the envelope has an additional role. Its very inertia delays the expansion of the reacting material. For this reason, such an envelope is often called a tamper. Use of a tamper clearly makes for longer lasting, more energetic and more efficient explosion. The most effective tamper is the one having the highest density. High tensile strength turns out to be unimportant. It is a fortunate coincidence that materials of high density are also excellent as reflectors of neutrons.

Efficiency

As has already been stated, the bomb tends to fly to bits as the reaction proceeds and this tends to stop the reaction. To calculate how much the bomb has to expand before the reaction stops is relatively simple. The calculation of how long this expansion takes and how far the reaction goes in that time is much more difficult.

While the effect of tamper is to increase the efficiency both by reflecting neutrons and by delaying the



The actual design of the atomic bomb is one of the deep military secrets which has not been disclosed nor is it likely to be, but it is interesting to speculate upon the probable design. The object is, of course, to bring parts of the bomb, each of which is below critical size, together so rapidly and effectively that all the atoms in the combined mass undergo fission simultaneously. Since the time elements are extremely short, the obvious method of doing this is to shoot one part as a projectile in a gun against a second part as a target, as shown above at A.

The chances are, however, that the critical size is considerably smaller than that obtained by dividing the amount of U-235 or plutonium in two parts as shown and that further subdivision is necessary. This requirement suggests an arrangement such as that indicated at B. Here a number of guns are arranged radially, each carrying a below-critical amount of fissionable material, aimed at a central target, also of fissionable material. An arrangement such as this may work well in theory but in practice it might not be effective because of the difficulty of firing all the guns at the same instant. It must be remembered that the time elements involved in bringing the component parts of the bomb together are of the order of millionths of a second and even if the guns were fired electrically it is questionable whether they could be fired simultaneously where such orders of time are concerned.

It is evident, therefore, that a more desirable arrangement would be obtained if the action could be produced by the firing of a single gun. One method which suggests itself is that of separating the below-critical masses of fissionable material by neutron-absorbing barriers such as shown at C, and pulling these barriers out by means of a projectile. The disadvantage of this scheme is that the component parts of the bomb might not be brought into intimate contact in sufficiently short time to produce an effective nuclear explosion.

Thus we come to the idea represented at D, where approximately half of the component parts are driven into the other half by means of a single gun. By shaping the masses of fissionable material into a number of wedges an intense packing action is obtained. The wedge shapes have a further advantage, however; they serve to keep the component parts away from each other as long as possible and when the critical distance between parts is finally reached almost complete union is obtained instantly.

The scheme, of course, is subject to many variations. As shown at D the projectile pushes one part of the bomb into the other. It could be made to "pull" the parts together so the explosive effect of the powder in the gun would not be directed into the area of the nuclear reaction, but this probably is of small importance.

expansion of the bomb, the effect on the efficiency is not as great as on the critical mass. The reason for this is that the process of reflection is relatively time consuming and may not occur extensively before the chain reaction is terminated.

Detonation and Assembly

As has already been pointed out, it is impossible to prevent a chain reaction from occuring when the size exceeds the critical size. For there are always enough neutrons (from cosmic rays, from spontaneous fission reaction, or from alpha particle induced reaction in impurities) to initiate the chain. Thus until detonation is desired the bomb must consist of a number of separate pieces, each one of which is below the critical size either by reason of small size or unfavorable shape. To produce detonation the parts of the bomb must be brought together rapidly. In the course of this assembly process the chain reaction is likely to start because of the presence of stray neutrons, before the bomb has reached its most compact form, that is, its most reactive form. Thereupon the explosion tends to prevent the bomb from reaching that most compact form. Thus it may turn out that the explosion is so inefficient as to be relatively useless. The problem, therefore, is twofold—(1) to reduce the time of assembly to a minimum and (2) to reduce the number of stray neutrons to a minimum.

Effectiveness

The amount of energy released was not the sole criterion of the value of the bomb. There was no assurance that one uranium bomb releasing energy equal to the energy released by 20,000 tons of TNT would be as effective in producing military production as say 10,000 two ton bombs. In fact, there were good reasons to believe that the destructive effects per calorie release decreases as the amount of energy released increases. On the other hand, in atomic bombs the total amount of energy released per kilogram of fissionable material increases with the size of the bomb. Thus the optimum size of the atomic bomb was not easily determined. The tactical aspect that complicates the matter further is the advantage of simultaneous destruction of a large part of enemy territory. For complete appraisal of the effectiveness of an atomic bomb, attention must also be given to the effect on morale. Actually, the bomb was detonated at such a height above the ground as to give the maximum blast effect against structures and to disseminate the radio-active products as a cloud. On account of the height of the explosion, practically all of the radio-active products are carried upward in the ascending column of hot air and disbursed harmlessly over a wide area. Even in the New Mexico test where the height of explosion was necessarily low, only a very small fraction of the radio-activity was deposited immediately below the bomb.

Method of Assembly

Since estimates had been made of the speed that would bring together sub-critical masses of U235 rapidly enough to avoid predetonation a good deal of thought had been given to practical methods of doing this. The obvious method of very rapidly assembling an atomic bomb was to shoot one part as a projectile in a gun against a second part as a target. (see Diagram A) The projectile mass, projectile speed and gun caliber required were not far from the range of standard ordnance practice but novel problems were introduced by the importance of achieving sudden and perfect contact between projectile and target by the use of tampers and by the requirement of portability. None of these technical problems had been studied to any appreciable extent prior to the establishment of the Los Alamos laboratory.

Naturally the actual details of the bomb had not been disclosed by the Army reports and it is not likely that they will be. However, from what has been said here, it would not be difficult for almost anyone to devise a design which might work. (see accompanying diagram).

The performance of the bomb first in the desert lands of New Mexico and later at Hiroshima and Nagasaki show how well the scientific problems involved in the construction of the bomb were overcome. The first experimental bomb was exploded at 5:30 a. m. on July 16, 1945, in a remote section of the Alamogordo Air Base, 120 miles southeast of Albuquerque.

Tension before the actual detonation was at a tremendous pitch. Failure was an ever present possibility. Too great a success, envisioned by some of those present, might have meant an uncontrollable, unusable weapon.

The final assembly of the atomic bomb began on the night of July 12 in an old ranch house. As various component assemblies arrived from distant points, tension among the scientists rose to an increasing pitch. Coolest of all was the man charged with the actual assembly of the vital core—Dr. R. F. Bacher, in normal times, a professor at Cornell University.

The entire cost of the project representing the erection of whole cities and radically new plants spread over many miles of countryside, plus unprecedented experimentation was represented in the pilot bomb and its parts. Here was the focal part of the venture. No other country in the world had been capable of such an outlay in brains and technical effort.

The full significance of these closing moments before the final factual test was not lost on these men of science. They fully knew their position as pioneers into another age. They also knew that one false move would blast them and their entire effort into eternity. Before the assembly started a receipt for the vital matter was signed by Brigadier General Thomas F. Farrell, General Groves' deputy. This signalized the former transfer of the irreplaceable material from the scientists to the Army.

During final preliminary assembly a bad few minutes developed when the assembly of an important section of the bomb was delayed. The entire unit was machine-tooled to the finest measurement. The insertion was partially completed when it apparently wedged tightly and would go no farther. Dr. Bacher, however, was undismayed and reassured the group that time would solve the problem. In three minutes time Dr. Bacher's statement was verified and basic assembly was completed without further incident.

Specialty teams comprised of the top men on specific phases of science all of which were bound up in the whole work, took over their specialized parts of the assembly. In each group was centralized months and even years of channelized endeavor.

On Sunday, July 14, the unit which was to determine the success or failure of the entire project was elevated to the top of a steel tower about 100 ft high. All that day and the next the job of preparation went on. In addition to the apparatus necessary to cause the detonation, complete instrumentation to determine the pulse beat and all reactions of the bomb was rigged on the tower.

The ominous weather which had dogged the assembly of the bomb had a very sobering effect on the assembled experts whose work was accomplished amid lightning flashes and peals of thunder. The weather, unusual and upsetting, blocked out aerial observation of the test. It even held up the actual explosion scheduled at 4:00 a. m. for an hour and a half. For many months the approximate time and date had been set and had been one of the high level secrets of the best kept secret of the entire war.

Nearest observation point was set up 10,000 yards south of the tower, where in a timber and earth shelter the controls for the test were located. At a point 17,000 yards from the tower at a point which would give the best observation, the key figures in the atomic bomb project took their posts. These included General Groves, Dr. Vannevar Bush, Head of the Office of Scientific Research and Development, and Dr. James D. Conant, President of Harvard University.

Actual detonation was in charge of Dr. K. T. Bainbridge of Massachusetts Institute of Technology. He and Lt. Bush, in charge of the military

(Continued on page 114)

Continuous Blowoff for Boiler Plants

Part I demonstrates by calculation and use of graphic chart how savings due to use of continuous blowoff can be estimated . . . Reasons for better boiler operation when using continuous blowoff system . . . Table of recommended limits in concentrations of total solids in boiler water . . . Calculation of water saved by continuous blowoff . . . Typical problems worked out . . . Part II, to appear in a subsequent issue will describe types of systems and their application in boiler plants

By Herbert G. Ebert and Joseph Thompson Sales Engineers, Cochrane Corp.

PRACTICALLY no other piece of power plant equipment yields a greater return on an investment than a continuous blowoff system. Any investment which can be amortized in five years is to be considered desirable, and a properly engineered continuous blowoff system which does not pay for itself within two years is rare indeed. In many instances, the cost of an installation is recovered within six months. Notwithstanding these definitely established facts, a surprising number of plants have not taken advantage of the possibilities of continuous blowoff.

Continuous Blowoff Saves Heat

Although there are many less tangible advantages to be gained through the use of continuous blowoff, the installation of a system can generally be justified by merely evaluating the heat recovered from the blowoff water itself. For example, a large eastern steam plant, about to install continuous blowoff equipment costing approximately $4,500 has been wasting heat equivalent to approximately $30,000 yearly through intermittent blowdown.

Because the calculations involved in determining the value of heat to be recovered in a particular plant are somewhat laborious, and very little general information is available concerning the cost of equipment needed to bring about this saving, Fig. 3 has been prepared. By means of this chart the approximate annual savings and cost of equipment, F. O. B. factory, can be determined for almost any plant. The theoretical aspects of the chart agree with the practical results obtained in over 50 installations now in successful operation.

The annual savings are based on the recovery of approximately 95 percent of the heat of blowdown for 24 hr operation per day, 300 days per year, with a boiler efficiency of 75 per cent and 14,000 Btu/lb coal at $5.00 per ton on the grates using a continuous blowoff system of a type which condenses flashed steam in an open heater. These figures are reasonable averages and the results obtained from the chart may be modified to suit variations from them. For example, in a plant operating only 12 hr per day, the annual savings figure given in the chart must be divided by 2. If 12,000 Btu coal is used, multiply by 14,000/12,000 or 1.167. If coal costs $4.00 per ton on the grates multiply the chart result by 4/5.

The costs determined from the chart show approximate limits for reasonable variation in design including ASME code or none-code construction of the flash tank, the former, of course, being the more expensive, variations in size and number of blowoff control valves, type of drainage equipment, etc. They are based on maximum working pressures of 50 psi for the flash tank and heat exchanger.

To use the chart it is only necessary to know the total dissolved solids in the total feedwater (condensate plus makeup) in ppm, the allowable boiler concentration, the total evaporation (all boilers) and the boiler pressure for the plant under consideration.

Continuous Blowoff Insures Smooth Boiling Conditions

To insure dry steaming, the solids concentration of a boiler water should be kept below certain limits. With intermittent blowdown, boiler water concentrations are erratic, varying from high to low points between blows, as is graphically shown in Fig. 4. The dangers of foaming and priming, if the limiting concentration of solids for a particular boiler is exceeded, are readily apparent.

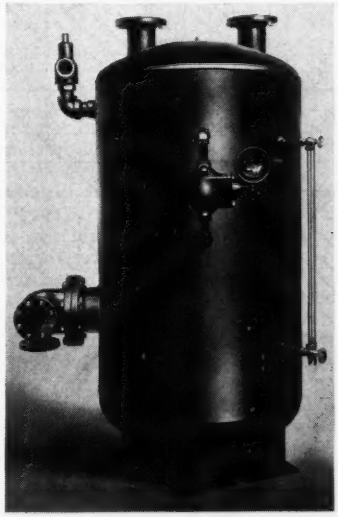


Fig. 1. Typical top inlet design of flash tank

Foaming is the carryover of moisture in finely divided particles, with the steam leaving the boiler. It is caused by the failure of steam bubbles to break easily and rapidly as they escape from the water in the boiler and is the direct result of high surface tension or skin strength of the bubbles due to boiler water impurities. These impurities most frequently are dissolved and suspended solids, but they may also be animal or vegetable oils, or any other saponifiable matter, carried into the boiler by returning condensed engine or pump exhaust.

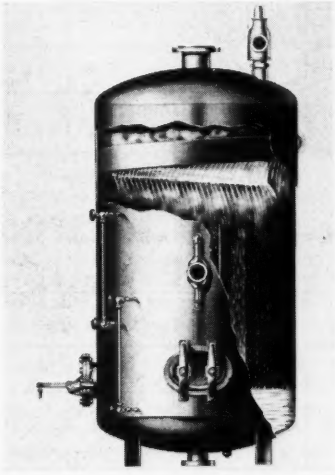


Fig. 2. Cutaway view of tangential inlet design of flash tank showing principle of operation

A good visual example of foaming would be the blowing of a jet of air through a strong soap solution. The resulting froth is similar to that formed in the boiler and in extreme cases this froth may completely fill the steam space, producing a heavy carryover of moisture. This may re-

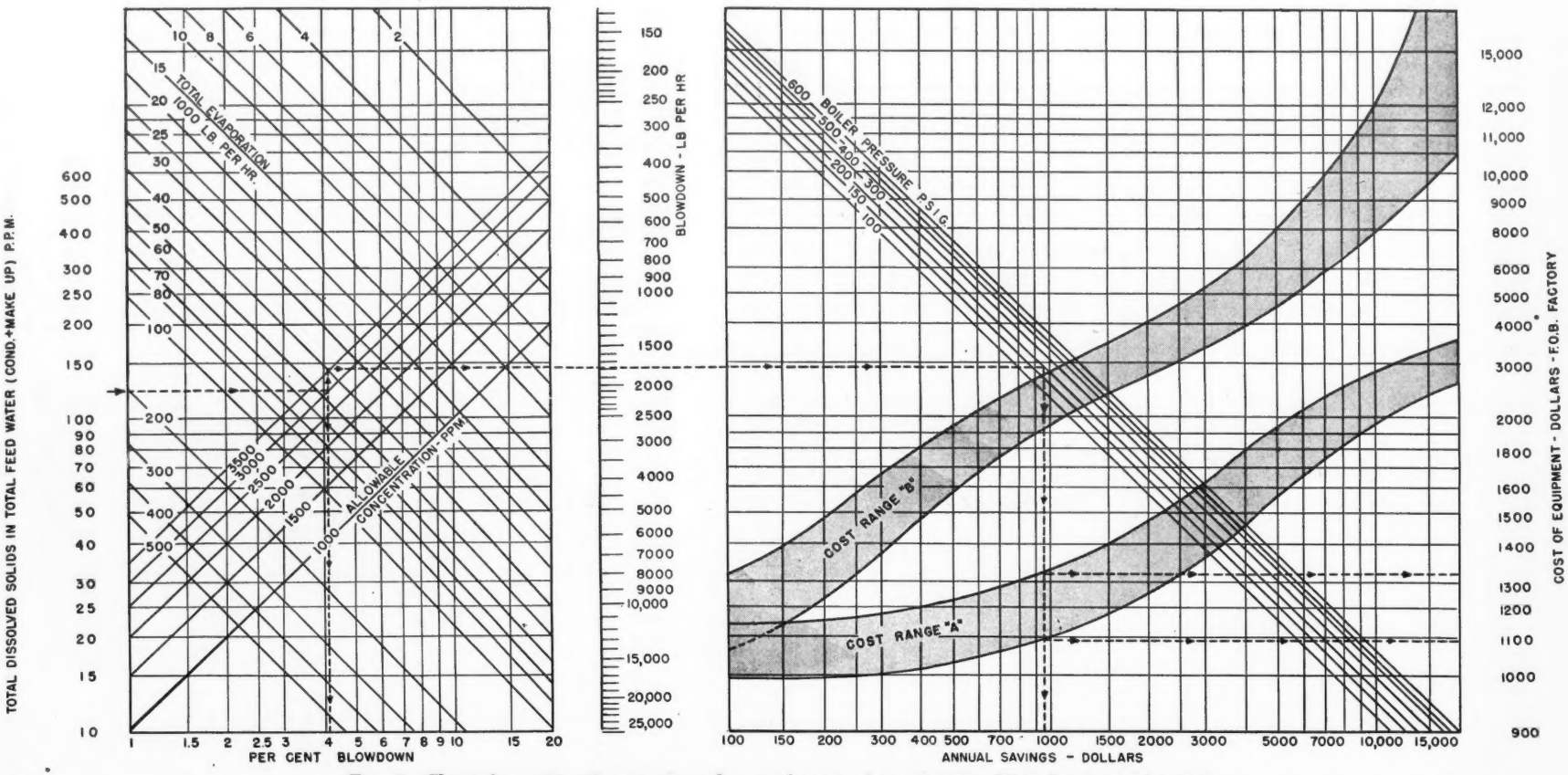

TOTAL DISSOLVED SOLIDS IN TOTAL FEED WATER (COND.+MAKE UP) P.P.M.
TOTAL EVAPORATION 1000 LB. PER HR.
ALLOWABLE CONCENTRATION - PPM
PER CENT BLOWDOWN
BLOWDOWN - LB PER HR
BOILER PRESSURE P.S.I.G.
COST RANGE "B"
COST RANGE "A"
ANNUAL SAVINGS - DOLLARS
COST OF EQUIPMENT - DOLLARS - F.O.B. FACTORY

Fig. 3. Chart for estimating savings by, and cost of continuous blowdown equipment

DIRECTIONS: The left hand abscissa is the total value of Total Dissolved Solids (TDS) in the total feedwater to the boiler including make-up and all returns. Its actual value is found by multiplying the TDS in the raw make-up by the per cent of makeup.

Example: Assume—

TDS. = 125 ppm.

Allowable boiler concentration = 3000 ppm.

Total evaporation = 40,000 lb per hr.

Boiler Pressure = 200 psig.

Enter chart at the left at 125 ppm and draw a horizontal line to the 3000 ppm Allowable Concentration line. Through this point draw a vertical line to the bottom of the chart and read the per cent of blow-down (4.2 approximately). Now extend the vertical line (if necessary) until it intersects the proper Total Evaporation line (40,000 lb per hr) and draw a horizontal line to the right from this point of intersection to the proper Boiler Pressure (200 psig), reading the total blowdown (1754 lb per hr) where the line intersects the blowdown column. From the intersection of this line with the proper Boiler Pressure line, drop a vertical line to the bottom of the chart and read the approximate Annual Savings ($950) for operation 24 hr per day, 300 days per year with 75 per cent boiler efficiency and 14,000 Btu per lb coal at $5.00 per ton on the grates. (For values other than these multiply the annual savings by the appropriate factor as for instance for 12 hr operation multiply the annual savings by one-half.)

Where this last line intersects the limits of Cost Range "A" draw two horizontal lines to the right-hand edge of the chart and read the approximate Cost of Equipment ($1090 to $1320) for a Class I system.

For total evaporations in excess of those covered by the chart, divide the total evaporation by ten and proceed as before multiplying the determined blowdown and annual savings values by 10 for final result. When this procedure is followed Cost Range "B" is to be used directly without multiplying any factor.

sult in steam line and turbine blade deposits or caustic corrosion in steam lines, valves, glands, expansion joints or any accessories where steam leakage takes place. In the majority of cases, foaming is the result of excessive boiler concentrations and can be eliminated or reduced to insignificance by a system of blowdown which prevents these high concentrations. Continuous blowdown does this very effectively.

Priming is the gross transfer of water from the boiler to the steam lines and may be due to insufficient steam release area in the boiler, heavy overloading of the boiler, or large pressure reductions. Proper control of boiler concentration by continuous blowdown will frequently help to reduce priming, but is almost never an absolute cure. Elimination of priming frequently requires drastic alterations in existing equipment or elimination of erratic or extreme boiler load and pressure fluctuations due to abnormal plant conditions.

Eliminating factors impossible to change because of the physical nature of the plant, and confining this discussion to the characteristics of the boiler water, one or more of the following may influence the control of boiler blowdown:

(1) Concentration of total dissolved solids.

(2) Concentration of alkalinity in relation to dissolved solids.

(3) Concentration of silica.

(4) Organic material in solution and/or suspended matter.

In most instances, the concentration of dissolved solids within the boiler determines the quantity of water which it is necessary to blow down.

The following general limits in concentrations of total solids in a boiler water have been recommended by the American Boiler Manufacturer's Association and Affiliated Industries:

Boiler Pressure, psig	Total Solids, ppm
0- 300	3500
301- 450	3000
451- 600	2500
601- 750	2000
751- 900	1500
901-1000	1250
1001-1500	1000

Specific limits in solids concentration, upon which a guarantee of steam purity has been based, can usually be obtained by contacting the boiler manufacturer and, if possible, this should be used in determining blowdown requirements.

Excessively high boiler water alkalinity is another contributor to conditions of foaming and carryover. The aforementioned Association generally recommends that the alkalinity of a boiler water be held at approximately 20 per cent of the total solids concentration. If some means for reduction of alkalinity external to the boilers is not provided, it is relatively simple to establish a safe blowdown schedule, based on concentration of alkalinity rather than solids. The alkalinity is allowed to build up and samples of the condensed vapor are taken at short intervals and tested for carryover by analytical or conductivity means. When carryover is encountered, the alkalinity concentration within the boiler is cut back 20 per cent and this value can be held with the assurance that difficulty will not be experienced from this source.

With waters of high silica content, silicious scales such as the analcite (sodium aluminum silicate) type are apt to be laid down on evaporating surfaces. Furthermore, silica present in carryover may deposit on turbine blades, necessitating their frequent scraping. To overcome these difficulties, it is common practice in high pressure boiler plants to control the amount of blowdown on the basis of silica concentration rather than concentration of total solids. It is generally recommended that the silica concentrations listed below for various boiler pressures be not exceeded:

Boiler Pressure— psig	Silica— ppm
200	100
400	65
600	45
900	30
1200-1500	5-10

These data have been compiled from a number of plants now in operation, feeding waters of high silica content to boilers, and by maintaining the concentrations shown, no tube scale or turbine blade deposits have been experienced. These data are not given with the intention of establishing a hard and fast rule for limiting silica concentrations in any or all boilers, but rather to set up a general reference based on the experience of others.

Continuous Blowoff Saves Water

Because continuous blowoff maintains boiler water concentrations at a constant safe limit, a saving in feedwater is effected. Every pound of water, prepared for use in a boiler has a definite value and every pound which is not eventually evaporated into steam adds to the cost of those pounds of steam which are produced. It is therefore, evident that the least amount of water that need be blown down to keep the boiler concentration at the proper point is the most economical amount.

Let us consider Fig. 4. The horizontal line A-B illustrates the constant level at which boiler water concentration may be kept through continuous blowoff. Under this condition all water blown down to maintain this level contains the same quantity of solids. Each pound pulls the same load as the next one in holding the concentration at the proper level. But in the case of intermittent blowdown, represented by the jagged black line, this is not true. Only in those rare instances at which the concentration is at exactly the proper level, does a pound of blowdown water contribute as much toward maintaining the proper concentration as in the case of continuous blowdown.

At all levels of concentration below the desired level, a pound of blowdown water contributes less toward reducing the boiler concentration than at the desired maximum. Obviously, more water must be blown down to achieve the reduction necessary to keep the concentration below the maximum until the boiler is blown down again. Only when the concentration has been allowed, through error, to rise into the danger zone above the desired maximum, does intermittent blowdown approach a favorable condition of water economy and under such circumstances the detrimental effects are prohibitive.

Let us study this effect in the case of a three-drum, low-head, bent-tube type of boiler such as is frequently found in a modern plant of moderate size. Assume that the boiler concentration can be kept at or below the desired maximum of say 2500 ppm by blowing one "glass" every eight-hour shift. If then the concentration is at exactly 2500 ppm at the beginning of a blow, it begins with the maximum efficiency, i.e., equal to that of continuous blowdown.

As the blow progresses, feedwater at a temperature below that of the boiler is entering the boiler at the maximum capacity of the feed pump or regulator, and, due to its comparative coolness, flows down the vertical tubes to the mud drum from which the blowdown water is flowing. Thus, the concentration in the mud drum is reduced without affecting the concentration in most of the other parts of the boiler. Consequently, the blowdown water now issuing from the mud drum is not carrying off as great a quantity of solids as that at the beginning of the blow. The actual quantity of water wasted in this manner is difficult to determine, being dependent on the rate of blow, the rate of and temperature at which the feedwater enters the boiler, the dimensions of the boiler components, and variable plant conditions.

Now, let us suppose the concentration, due perhaps to operation at low loads, is only 2250 ppm at the time of the blowdown. Each pound of blowdown water now carries off only 90 per cent of the solids that were carried off when the concentration stood at 2500 ppm. While it would actually not be necessary to blowdown as much this time because the concentration is lower to begin with, that quantity which actually is blown does 10 per cent less work toward decreasing the boiler concentration than was previously the case and a corresponding additional amount of water must be blown to waste to achieve the required results.

Still another condition of boiler operation under which continuous blowoff affects a sizable water economy can best be illustrated by assigning some definite figures to our hypothet-

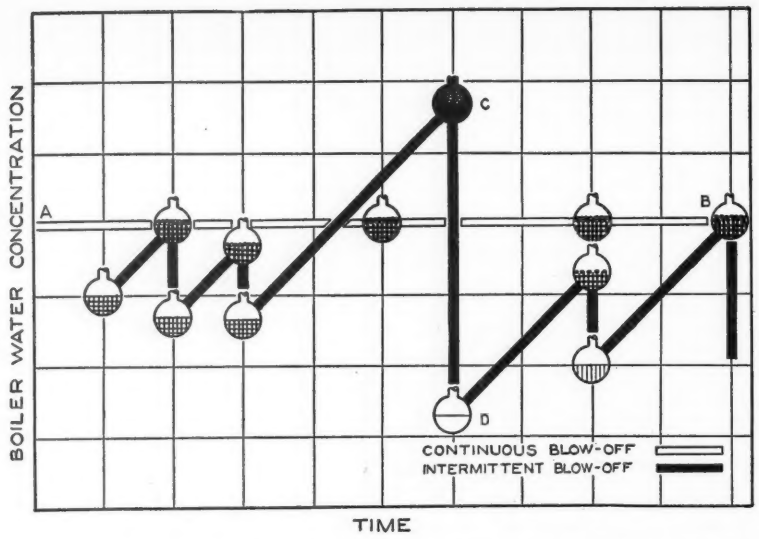


Fig. 4. Graphic representation of contrasting effects upon boiler concentration of the continuous method and of the intermittent method of blowing off boilers

ical boiler. Let us assume the following condition of operation:

Total evaporation—12,000 lb/hr at 200 psig

Total water capacity of boiler—20,000 lb

Make-up—100 per cent with total dissolved solids of 125 ppm

Allowable concentration in boiler—2500 ppm

Quantity of water blown down for each blow of one "glass"—2000 lb

In order to hold the concentration in such a boiler at or below 2500 ppm with intermittent blowdown, it would be necessary to blow down every 3.17 hr. But now let us assume that for reasons of economy in attendance, firing or perhaps to keep the full evaporating capacity of the boiler available over a considerable period of time, it becomes desirable to limit the blowdown periods to about 6 hr. It is now necessary to blow two glasses at each blowdown period. Starting with the concentration at 2500 ppm and blowing one "glass" the concentration will stand at 2262 ppm after the boiler level has been restored by makeup (neglecting the effect of continued steaming, which will increase this figure somewhat, but will have no effect on the final result). This reduction will permit 3.17 hr of steaming before blowing down again, but we require about 6 hr, so another glass must be blown after the boiler has made its level.

Blowing this second glass will not effect the same reduction as the first since the boiler concentration was lower at the start of the second blow and after restoration of the level the concentration will stand at 2048 ppm. This will permit an additional 2.85 hr of continuous operation and bring the total to 6.02 hr which will be satisfactory. To accomplish this 4000 lb of water was blown to waste while with continuous blowoff at 5 per cent the concentration would have been maintained at 2500 ppm and only 3789 lb of water would have been blown down. Intermittent blowdown, therefore, caused an additional water waste of 5.6 per cent.

If this plant had been equipped with a continuous blowdown system with a flash tank operating at 5 psig, 17.5 per cent of the blowdown water would be recovered as condensate from the flashed steam. Summarizing the total water economies effected by continuous blowdown, we can estimate the loss due to the mixing of feedwater with the intermittent blowdown as 2 per cent, the average loss due to blowing down before the maximum concentration is reached as 2.5 per cent and, adding these to the loss of 5.6 per cent described in the previous paragraph, we have a total of 10.1 per cent. Now add the 17.5 per cent of flash steam condensate recovered with continuous blowdown and we have a total of 27.6 per cent more water used with intermittent blowdown for this particular case. Actual conditions of operation would, of course, make this figure variable. But the fact remains that a considerable water economy can be effected by properly designed and installed continuous blowoff systems, a point that is all too frequently neglected in attempting to justify such installations.

The annual dollar value of heat recovery has been discussed in previous paragraphs, but includes only the heat recovery from the actual blowdown with continuous blowoff in operation. The heat loss due to the 10.1 per cent additional waste caused by intermittent blowdown for the conditions assumed in the example cited represents a loss of approximately 4,810,000 Btu per day or $343 per year on the basis used in preparing Fig. 3.

(To be concluded.)

Floating Power

(Continued from page 71)

particular localities. The transformer is located in a separate well and is rated 37,500 kva with voltages on the high side of the transformer at 69,115, and 138 kva. The 69 and 138 kva is obtained by internal series parallel connections on the terminal board. The 115 kva is obtained by taps taken from the 138 kv winding. The high voltage leads go up through a hatchway to a supporting structure on deck. Here, high voltage lightning arresters are located for the protection of the lines. Shore line connections from shore transmission lines will be brought in overhead to the transformer connections located in the supporting structure. The hatch, through which the high voltage lines are taken, is kept closed while the barge is in transit.

In order to start the power plant from cold, two 300 kv auxiliary Diesel-driven generators are furnished to supply auxiliary electric power.

The operation of this power plant is comparable with that of modern central stations. The performance on test at full load with 1.5 in. Hg absolute back pressure was 11,250 Btu per kilowatt hour, including all auxiliary requirements.

The regenerative cycle consists of a high-pressure heater, a deaerating heater, a low-pressure heater and an evaporator. Steam for the evaporator is taken from the high-pressure extraction line and the drips are put into the deaerator. The evaporator steam, as well as the drips from the high-pressure heater, are also put into the deaerator. A jet condenser is in the line ahead of the low-pressure heater and its drips are passed back to the hot well. This cycle results in a good turbine heat rate.

Keep Gear Lubricant Clean

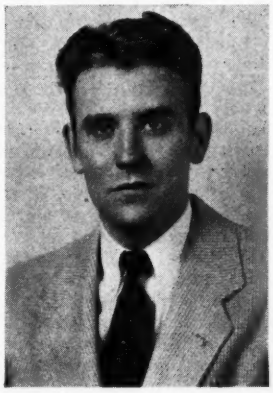
OPERATING ON the logical premise that there is a cause for every malady, last year Westinghouse Engineers ran to earth the reason for a most mysterious but also annoying local epidemic of excessive gear wear. As so often the case, the cause was a simple one. Fly ash or other abrasive dust was getting into the lubricating oil. That hard dirt particles in gear lubricant are not good is not a new idea, of course. But it had not been generally appreciated how little abrasive dust—fly ash, ore dust, or even log-bark dust—need be present for consequences to be serious. In one case, gears of a turbine-driven induced draft fan were wearing and becoming noisy in matter of days. Analysis of the lubricating oil indicated a small amount of fly ash. Applying adequate oil filters completely solved the trouble.

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

Meet RALPH B. BARNES, Jr.

Our New Assistant Editor



Newest member of our editorial staff is a young Army veteran, Ralph B. Barnes, Jr., a graduate of Purdue University. He has been in the Army since 1943, served as a 1st lieutenant with Patton's 3rd Army in Europe and received his discharge in January, when he joined our staff.

As a 2d lieutenant in the Ordnance Department, his first overseas assignment was as assistant to Captain George F. Stafford, Regimental Adjutant of the 333rd Engineer Regiment, who was in charge of the three power plants—the USS Donnell (see page 99), a damaged destroyer escort, the Cherbourg city power plant and the Arsenal plant—which furnished electricity for the Cherbourg, France, area. He left the engineers to return to the Ordnance Department just in time for the "Bulge." In that operation, he was motor maintenance officer in an ordnance field depot company.

Mr. Barnes was born and raised in Oak Park, Ill., a suburb of Chicago. He won a regional scholarship to Purdue University in competitive examination, entered the mechanical engineering course in 1940 and, as a private in the Army, with GI khaki under his cap and gown, received the degree of B.S. in mechanical engineering in August, 1943. After a 17-weeks OCS course at Aberdeen Proving Ground, he was commissioned a 2d lieutenant in April, 1944.

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A Section of Power Plant Engineering Devoted to PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

Engineering by Trial and Error

Here is another article by Mr. Brown that will make any good engineer's hair stand on end. Mr. Brown, it may be recalled wrote the article "The Chief—'He Don't Know Nothin' About Engines'" in the March, 1945 issue. That heartbreaking account was about an engine; this one is about a boiler plant and a misinformed manager who did not have sense enough to give the engineer he hired the authority he needed. Whether it was patriotism or mere curiosity which kept Mr. Brown on the job to the bitter end we do not know but stick it out he did and with good results. There should be a distinguished service medal or something comparable for men like him.

By ROY L. BROWN

PERHAPS the title of this article is not the most appropriate one, but for the lack of something better I will call it that. It could be called by several names but I doubt if one could be found that could be printed that would do justice to the power plant described here and the men that were in authority.

Anyway, when I heard that this particular company was in need of an engineer to repair and completely remodel its power plant I was free to go look the situation over. After considerable talk we agreed upon the salary and other items such as the men that I was to have, the type of equipment to be installed, the time allowed for completion, also who was to have charge of the job.

It was in this last respect that I got the greatest surprise of my life. If I had known what was going to take place, I would have gotten out of that General Manager's office in a hurry and kept right on going.

It seems that when a fellow has followed the engineering game for a while he gets to trusting everybody, or something like that. He figures that, maybe, there will be a way out after all if he works long enough and hard enough.

Came the following Monday and I reported for duty. Also I got a treat that I hadn't had in a life time; I got an opportunity to really have a look at those old boilers. What a battery of kettles they were!

Just a Little Bulge

It seemed that there had been a little trouble the year before, shortly before the season's run had closed—just a little bulge in the back sheet. It looked like an old mixing bowl that my grandmother used to mix the butter in. I asked the manager "how come" this bulge was there. He told me that the fireman had gone to sleep.

Of course, this manager was very nice about this now that he had hired an engineer. I could get a hammer and beat the bulge back into shape. I tried to explain to him that the job would be next to impossible, also, that the State Boiler Inspector would have to O.K. the job before and after. So after much argument I convinced him that perhaps he should call the Inspector if only to prove that I was wrong.

The Inspector condemned the boiler at once and also insisted that three other old fire-tube boilers that made up that battery be completely overhauled and cleaned of all scale. This was something the manager had not figured on and it was somewhat disconcerting since it would leave him short of steam. Steam had been very short the season before, and no wonder judging by the amount of scale on those old pots. The tubes were almost choked together in places.

Here again the manager tried to beat the game by welding stubs on the ends of the tubes after we took them out. It seemed that there was always a block in the managers way, for those tubes were just too thin. That nearly broke his heart as he had been figuring how much money he was going to save the packing company. Naturally it never occurred to him what the cost would be if the boiler should blow up.

When I made an effort to explain what would happen should the boilers blow up, he informed me that he had talked to their master mechanic and the master mind had given his O.K. in this method of retubing these old boilers.

Said He Bribed the Inspector

This was the first that I knew that I was to take my orders from the Master Mack too, but I was soon to learn that I was in for a lot of surprises. We called up the boiler inspector again. He said that all of the tubes would have to be new ones. You ought to have seen the faces on the manager and the master mechanic. Right away I get blamed for bribing the inspector. Who ever heard of such a thing? We who work around these old obsolete power plants have these competent men to thank for our lives.

After several days delay the tubes arrived so we got to work. In the meantime, however, I have been checking this old packing plant over just to see what makes it tick. Well! Everything is nice and handy. They never overlooked a thing when they first built that place. All of the pumps were down in a hole or set so close together that they had to be moved off their foundations to pull one of the rods.

There aren't any engineers in this plant but there are several compressors, steam traps and several thousand feet of pipe ranging from ¼ in. up to 8 in. and scarcely any of it lagged with pipe covering. There was also evidence of leaking joints everywhere. It is no wonder that they had so much labor trouble out in the rooms where the packers worked.

The job of retubing these old boilers was a difficult task. We were handicapped in a good many ways, such as small space to work in and being forced to work in, and around the brick masons who were, at that time, rebuilding the fireboxes and the brick work from the ground up.

This power plant could have been rebuilt into a modern plant if there had been some organization and management about this work, but it was done according to the whim of anybody that had an idea and who happened to wear a white shirt and who had a job with a little authority. Believe me, it was a mad house to work in, but I was learning fast, and what I had to say about the situation was of little interest to these self-made men.

Eventually my crew had to work on the installation of the flues so as not to bother the masons but we were not permitted to do this until several days were lost trying to work in the other fellows' way. Why do the managements of some concerns hire an engineer who through years of experience or study is supposed to be a competent man, if they don't need an engineer and haven't the confidence in his ability to do his job? I cannot see why they don't do the job by themselves. It seems that these fellows think that they must dictate every move no matter how insignificant such as the installing of a bolt in a flange or putting oil on the flue roller. All of this procedure has been learned a long time ago by the competent engineers.

As the work progressed with the tubes we ran into more trouble. The air compressor was too small to lay the beads down onto the sheet, so I went to the manager and asked him if he couldn't borrow a larger air compressor or arrange to start up an old motor-driven Ingersoll-Rand compressor which could have been put into working condition in about a day or so.

Here was where I ran into another blank wall. I was told that the com-

pressor was plenty large enough since some other fellow had used it about ten years before to install about six tubes in one of the boilers.

I could not get anywhere, even after I showed him the table showing the amount of air required. A ten-year old boy could have told him that there was something wrong. When the air pressure reached 100 pounds, which took a long time, some 20 minutes had to elapse after rapping one of the tubes just a little for the air to regain its normal 100 lb. pressure.

While writing this I have my diary before me which I kept day by day while on this job. After looking it up, I find that it took us 2½ hours in each tube that we installed in those boilers. It would have been cheaper for them to have bought a compressor or repaired the old Ingersoll-Rand, because all that was wrong with the Ingersoll was a burned-out bearing and leaky valves.

As the time went by the manager began to get worried. It was getting nearer to the fruit harvest all the time. Everyday he was butting in with new ideas that his master mechanic had told him would save time. I never saw so many changes in a power plant in all my life. One day he would want to place one of the boiler feed pumps in one position and the next day he would want to change it, usually after my man had the installation nearly completed.

Blue Prints? Why Use 'Em?

I expect the reader will wonder why, in heavens name, didn't I install the equipment according to the blue prints furnished by the management. The answer to this is simple—there just were no blueprints.

That was the reason that I was hired, so I eventually found out, so that I could install the power plant equipment. Naturally, I didn't need any blue prints. I was supposed to put the So-and-So Plant up, ready for steam without all of those unnecessary drawings.

I drew up a sketch for my men so they would have something to go by, as I, too, had to have something for reference. However, my judgment wasn't worth a tinker's dam as I was given to understand I hadn't consulted the assistant superintendent and the Cooker Foreman. This was another new angle I had overlooked when I took this job. Of course, these nice gentlemen had lots of good ideas themselves on how to design a power plant, also to take charge of the construction. It seemed that these fellows were to be my co-partners in the final decisions.

Most everybody knows that old saying about too many cooks spoiling the broth. Well, believe me, the soup at this place was being spoiled pretty fast.

Why didn't I quit you will ask? Well, maybe it is because I did not want to ruin what little reputation I had, and I felt it my duty on account of the war going on. After all, I had asked for the job, so I couldn't walk out on them when they needed help.

Sometimes I think it would have been better if I had left them with all their troubles, but I had a fine crew and it just didn't seem right. I have learned that it is pretty hard to convince a man who is your superior that perhaps he doesn't know just all there is to know about such things as a power plant.

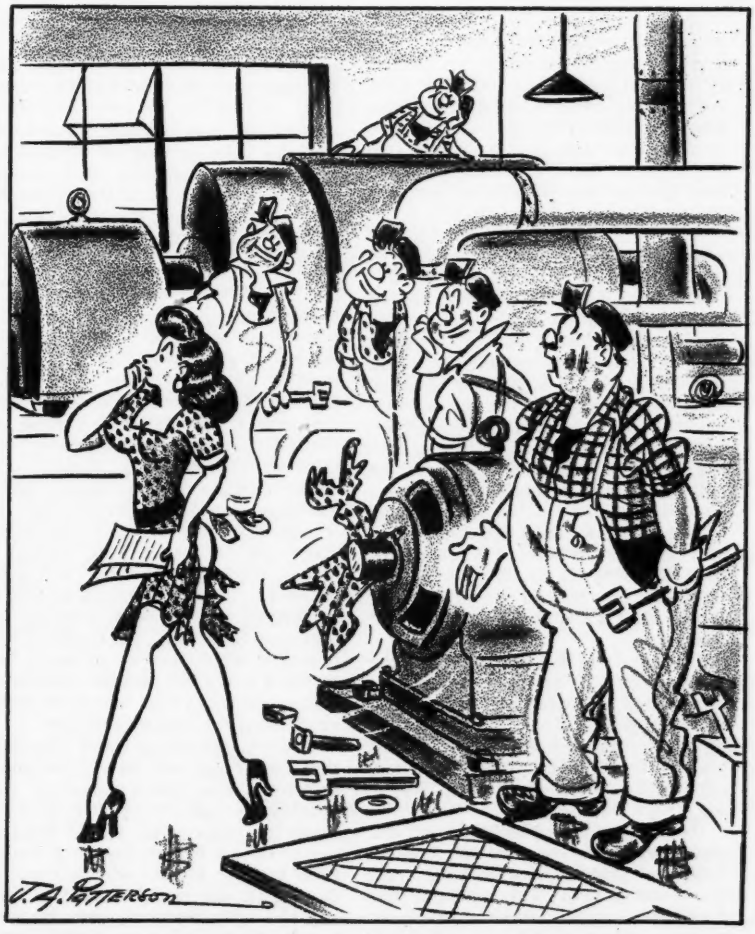
That is the barrier that a lot of engineers are up against today. The man who is their superior is not an engineer. In most cases he is a competent executive as regards to the manufactured product. This manager that I was working for was one of these fellows, and afterwards I was to find out that he was also a fine chap to know, and I feel that he is one of my best friends.

A New Boiler Arrives

However, he was a long time in getting things straight in his mind. It was at about this time late in March that we got a surprise from the head office. They told us that they were sending us a 500-hp Heine boiler. No plans had been made for this boiler so it was a case of doing something quickly. The manager called the assistant superintendent and the master mechanic—also yours truly into consultation.

As matters stood there was available space to set the boiler but the pumps, hot well, and some small pipes would have to be moved. Even the assistant superintendent and the master mechanic should have been able to figure that one out.

At that meeting I offered a suggestion or two but I soon saw that it was hopeless for an engineer to offer any suggestions. They soon over-rode my sketches and figures with their authority. They assured me that I would not have any trouble making the installation their way. It was then that I lost my seniority. The manager didn't seem to think that I was capable of taking charge of the unloading and the erection of the H beams, etc., necessary for the hanging or suspension of so large a boiler. Of course, it would be all right for me to install the piping water columns, pumps, etc.



"But, Miss, I tried to tell you, you were standin' too close to that motor!"

I thought again of leaving but I just stayed on, mostly because I wanted to see the excitement when the manager finally woke up, as I knew he would. It seems that a steam power plant just cannot be built to work with efficiency without someone first laying out a plan that has been tried and proved to be successful. I had tried pretty hard two or three times to make these people see this but it was of no use. They would not listen—all they wanted me to do, so it seemed, was to work under orders.

In a few days the boiler came loaded on a large truck. It was the duty now of the superintendent and master mechanic to get it unloaded and suspended. Nothing had been prepared for the arrival of this boiler so it was a mad rush from the start. I never heard so much shouting and bellowing of orders—get this or go do that. The master mechanic had the men half loco before any real work could be started.

He had one thing to his credit, however. He used his good judgment when he gave the welder a free hand in the measuring and cutting of the H beams. That was one thing that fit when the final work was done.

New Boiler Falls Over

The master mechanic put the men to work jacking the boiler up off from the bed of the truck but instead of using four jacks, he used two. Perhaps he never played teter-toter when he was a boy, but he was soon to find out. He got up about two feet with the boiler and over she went. Perhaps God was with those men that day and it just was not their time to go. Two of the fellows were hurt so seriously, however, that they had to be off work for a long time.

This accident did not help us on the time situation a bit, and it was the beginning of the end for this master mechanic. The manager called in some men from a local machine shop who were familiar with setting machinery, and who had the equipment for setting it. After those men got on the job it didn't take long until the boiler was hung in position. This was also a break for me as the foreman of the machine shop had known me several years before. He asked the manager why he hadn't given me complete charge and a lot of other things, that I didn't know of at that time.

The next day I was called into the manager's office and I was told that the master mechanic had been transferred and that I could have charge of the entire installation of all the plant. It seems that these managers get jittery when their jobs are in jeopardy.

By now the time was late April and the fruit season on at about June 10 with the power plant a long ways from completion. The manager and I had a lot to talk about that day as the very things that I had asked him to grant me in the beginning had to be thrashed out now. So many blunders had been committed, that it was going to be a miracle to get ready in time. The manager sensed this after I gave him my final sketches of the plant, also the necessary valves, fittings, etc. At that particular date they had not been ordered. He had been under the impression that everything necessary for the completion of the power plant was in stock in the Packing House store room but upon making inventory of the store room he was sadly mistaken. The requisitions that I had sent in at the beginning of my employment had not been filled. I had a carbon copy on file but there were no records in the shipping clerks office. Naturally you can guess who I gave the requisitions to. It was the master mechanic.

However, what was done could not all be undone in a short time so we had to do some figuring to see what could be used and what we would have to change.

The brick work around the fire tube boilers had all been completed so it was difficult to change much of that. It was at this time that I suggested a trial run of the fire tube boilers to see if the furnaces would work. They did not seem to look right to me and each one was of a different design. This was in accordance with the notions of the master mechanic and cooker foreman and several others that had just an idea all their own.

The trial run was just what I expected. The furnaces back-fired, smoked, and sputtered. It was hard to keep them going. If they were going to produce any steam to can the fruit with, a number of changes were in order.

Gets Help from PPE

It was at this point that I wrote to the editors of Power Plant Engineering for their advice on the proper type of oil-fired furnace. And upon the receipt of their kind letter with the correct information, we made the desired changes in the furnaces with the results satisfactory to all.

The furnace of the Heine Boiler had been installed under contract but it was not hard to make the necessary changes as it only lacked a bridge wall to make the hot gases follow the baffling. This Heine Boiler performed well, though after it fell over and back onto the truck, it was feared it would not be of much use. It was a lucky fall because there were just a few tubes that had to be tightened when the test was put on.

This was one of the worst situations that I ever got into in my life and I sincerely hope that I never get into another one just like it. Yes, we were ready on time with a full head of steam on all boilers but if it hadn't been for the loyalty of the crew by digging in and working hard to remedy the mistakes that were made in the beginning, that particular plant would not have been in production for a considerable time after the beginning of the fruit harvest.

The plant is now operating on a 23-hr. schedule, but my work there ended when the power plant was finished. There was lots of work that should have been done but there was not sufficient time—things such as the installation of steam traps and automatic water control, so that should the night fireman fall asleep there would not be another accident. Also the installation of automatic oil and gas burners—these were all ordered but were not installed.

Perhaps some of the readers are familiar with cannery procedure. Once you are under steam it is next to impossible to shut down the power plant until the final run of the season is finished.

No doubt, next year when the season run is started things will be different because I doubt if the manager will be fooled again by some of his assistants. I only wish that other fellows could have the opportunity to learn about a power plant the way this man did.

He Doesn't Want to Retire

A GOOD FRIEND of ours, a very experienced and competent engineer, came to us with a rather sad story a few days ago. This man has been the superintendent of power for a large industrial plant in the Chicago area for many years. This company, it seems had a rule that an employee was eligible for retirement at the age of 65, but that he had the option of continuing work until he was 70 if he so desired.

This man has just reached the age of 65 and suddenly, without warning, he was retired without the benefit of the option which he assumed he would have the privilege of exercising. Of course, his retirement is on a pension, but he feels that he does not want to retire and wonders whether he cannot get a position as chief engineer somewhere else. As he says, he does not feel that he is too old to work and his work is really his only real interest.

His case is typical of many men who have made their work practically their sole interest and who, when retirement is forced on them, feel lost. The fault is their own, of course, not the system which creates the condition. Men who develop outside interests or hobbies do not have any trouble adjusting themselves when it becomes necessary or expedient for them to retire, in fact they welcome the opportunity.

Nevertheless, when it happens to a man such as our friend referred to above, it comes as a severe blow and there should be a place for him somewhere in industry. Naturally he doesn't consider himself as ready to go on the shelf and in view of his experience and knowledge he could be extremely valuable to some organization if only in a consulting capacity. If anyone reading this thinks that they may have use for a capable man, who knows the power plant field from the ground up even though he is 65 years old, let us know and we will put you in touch with him. A. W. K.

Single Phase Load from 3-Phase Supply

By C. O. von Dannenberg

Here is an interesting discussion of a subject that has long been a source of considerable controversy among electrical men. It concerns the possibility of obtaining single phase current from a three-phase system with balanced conditions. Very little information on the subject appears in handbooks or other electrical literature. Offhand, it seems easy but it does not work out very well in practice. The subject is of importance today because of the growth of the electric welding art which makes three-phase balancing difficult. Automatic changeover devices have been suggested but these mean added expense. Mr. von Dannenberg discusses two systems, the series method and a "conventional" delta connection. The worst element of the series method is the "rotten" regulation it provides but it takes more than telling many practical men about this to keep them from trying. In utility practice the series-booster transformer is a "headache" if ever there was one, with its wide voltage variation, so the suggested three transformer in series method for a three-phase supply, single-phase feed is even a worse headache.

The delta-connected bank, with the added advantage of being able to deliver 3-phase as well as single-phase with very good regulation, together with the possibility of making the two series legs carry more load with a simple balancing, brings us back to the more conventional methods. The material in most textbooks and handbooks is too sketchy and general in discussing single phase and unbalanced loads. While this consideration of the subject by Mr. von Dannenberg is not intended to be comprehensive, it presents many points of interest and serves to warn readers who may be inclined to rush in where angels fear to tread.

THE ANALYSIS of the details of a condition given in the title indicates features not usually referred to in publications and general literature.

The marked increase in single phase loads, due to welding and similar applications, has required much planning to enable balanced conditions to be approximated for a 3-phase supply circuit. A balanced circuit is, of course, one in which the currents in the lines are all the same, the voltages line to line or line to neutral the same and the power factor the same for each single phase load, this means of course three equal watt (or kilowatt) loadings as measured.

The supply circuit side of the transformer bank under consideration may be either star or delta connected, and whatever load condition exists on the secondary or load feeding side is exactly reflected in the supply circuit, so any analysis need consider only the conditions resulting on the side feeding the load where the connections in this situation are arranged to supply a single phase load. Without going into detail, a study indicates, that all types of secondary connection lead to the same general conclusions, hence one, only, will be given on the score of simplicity.

A three phase bank, shown with secondary connections only, Fig. 1 consists of three units of equal rating, A, B and C; the ends of the windings are numbered for identification; the phase sequence is given in Fig. 2 and Fig. 3 shows the no load voltage relations. The transformer units are delivering voltages E_a, E_b and E_c; the current I is common to all; E_f is the voltage impressed on the circuit being fed.

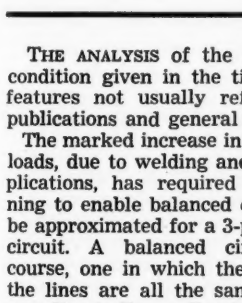


FIG. 1

Fig. 1. Series connection

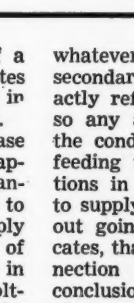


FIG. 2

Fig. 2. Phase sequence of connection shown in Fig. 1

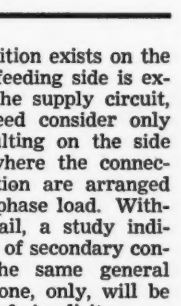


FIG. 3

Fig. 3. No load voltage relations of circuit shown in Fig. 1

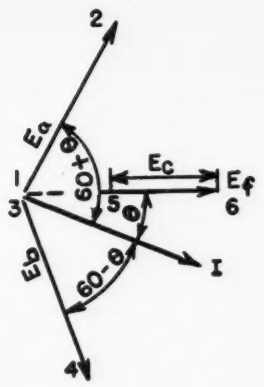


FIG. 4

Fig. 4. Voltage and current relations under load

It is assumed the load current K lags the feeding voltage E_f by the angle θ and since the current I is the same for each winding it serves as a base of reference and the relations of the voltages to it, in A, B and C are as shown in Fig. 4.

It is clear that the value of the no-load feeding voltage E_f, the vector length from point 1 to 6 is two times E_a, E_b or E_c, and we have an equality of values, expressed as follow:

(1) Watts (or kilowatts) $= E_f\ I \cos \theta = E_a\ I \cos (60 + \theta) + E_b\ I \cos (60 - \theta) + E_c\ I \cos \theta$

Since I is common to each expression and, as stated, E_f is twice the other voltages we can rewrite the expression:

(2) $2 \cos \theta = \cos (60 + \theta) + \cos (60 - \theta) + \cos \theta$

expanding $\cos (60 + \theta)$ and $\cos (60 - \theta)$ by trigonometrical rules we get:

(3) $2 \cos \theta = \cos 60 \cos \theta - \sin 60 \sin \theta + \cos 60 \cos \theta + \sin 60 \sin \theta + \cos \theta$

which through elimination results in a simplified expression:

(4) $2 \cos \theta = 2 \cos 60 \cos \theta + \cos \theta$.

As $\cos 60 = \frac{1}{2}$, so through substitution we get:

$$2 \cos \theta = 2 \times \tfrac{1}{2} \cos \theta + \cos \theta$$

or

(5) $2 \cos \theta = 2 \cos \theta$

proving the initial assumption in (1).

To indicate the effect of the relative loading for the different transformer elements at different power factors a table follows:

The angle of 90 degrees is an imaginary one. Note the quality of the values of columns 4 and 5.

The relative loadings in columns 6, 7 and 8 are of greatest interest as they show the relative unbalance, it is doubtful whether under actual conditions a load with zero angle of lag or 100 per cent power factor will be

Angle—Degrees			Cosine Values — Power Factor					Relative Loading Ratio — Per Cent		
			1(c)	2(a)	3(b)	4	5	6	7	8
θ	$60 + \theta$	$60 - \theta$	θ	$60 + \theta$	$60 - \theta$	1 + 2 + 3	2 cos θ	1/5	2/5	3/5
0	60	60	1.000	0.500	0.500	2.000	2.000	50	25	25
30	90	30	0.866	zero	0.866	1.732	1.732	50	zero	50
60	120	0	0.500	—0.500	1.000	1.000	1.000	50	—50	100
90	150	30	zero	—0.866	0.856	zero	zero	zero	$-\infty$	$-\infty$

found so for any condition the load with a connection arrangement as indicated will be even more greatly unbalanced; at 30 and 90 degree lag angles one unit carries no watt load.

The usual comment, about the relative loading of the different transformer elements, speaks of the 50, 25 and 25 per cent energy loading but as can be observed from the table this is only true for one condition.

There is also in addition to the unbalanced energy loading the difference in the voltage regulation of each unit due to the different power factor relation which makes itself evident in the variation of the feed voltage E_f from no-load to full load.

Supplementing the discussion of this subject concerning the results obtained through the use of a non-standard connection, the same consideration to the use of conventional arrangements seems in order.

Given the delta connected bank Fig 4 with the phase sequence as in Fig. 5 and the load fed from bank terminals 1-6 and 4-5 the conditions for the current flow are different from those existing in the non-standard, or perhaps better termed, non-conventional connection where each winding carried the total current and of practical necessity each phase unit winding had of necessity the same volt-ampere rating.

We have for the condition now being considered two paths for the load current to follow, one directly from transformer element C which includes the winding having terminals 5 and 6, and a parallel path which includes elements A and B in series by the way of terminals 1-2—3-4. The relative value of the currents flowing in the two circuits will, of course, depend upon their impedances. Figure 6 gives the vector relations of the three element voltages and the load current for a lagging condition.

Assuming A, B and C all to have the same impedance it is clear the load current in the two circuits will divide in the ratio of 1 to 2 so we can express the relations as follows:

$$(1)\quad EI\cos\theta = E_c\frac{2I}{3}\cos\theta + E_a\frac{I}{3}\cos(60+\theta) + E_b\frac{I}{3}\cos(60-\theta)$$

and by eliminating the equal quantities on each side of the equation, (1) can be simplified to:

$$(2)\quad \cos\theta = \frac{2}{3}\cos\theta + \frac{1}{3}\cos(60+\theta) + \frac{1}{3}\cos(60-\theta)$$

expanding through trigonometrical rules the expressions cos $(60 + \theta)$ and cos $(60 - \theta)$ results in a total value, adding all three, of cos θ to prove the correctness of the initial equation. It is clear from (2) that the total voltamperes will be ⅔ + ⅓ + ⅓ or for the total watt load 4/3 in capacity which in relative percentages for the total watt load are 66⅔, 16⅓ and 16⅓ using standard transformer units all assumed to have the same impedance. These percentages compare with those of 50, 25 and 25 developed for the series connection where each unit had to of necessity be of the same voltampere rating. It would be possible of course to adjust the impedance, through suitable means, of the element, circuit "c" and cause the same current to flow through each branch. Equation (2) for such a condition would then take the form:

$$(3)\quad \cos\theta = \frac{1}{2}\cos\theta + \frac{1}{2}\cos(60+\theta) + \frac{1}{2}\cos(60-\theta)$$

which indicates relative watt loads of 50, 25 and 25 per cent. The actual values would depend upon the load power factor or cos θ as related to the elements of the equation.

It is of interest, if the reader is inclined to speculate upon the possibilities of the delta connection, to consider what may result when other adjustments are made in the impedance of element "c." This could be carried to any degree desired, at the expense of course of having or obtaining unbalanced currents with more nearly balanced watts and it seems unnecessary to continue the analysis since the methods are relatively simple and can be concluded for each condition arising.

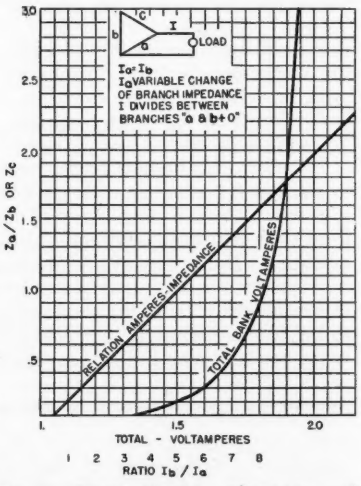

LOAD
$I_a = I_b$
I_c VARIABLE CHANGE OF BRANCH IMPEDANCE I DIVIDES BETWEEN BRANCHES "a & b+c"
Z_a / Z_b OR Z_c
RELATION AMPERES - IMPEDANCE
TOTAL BANK VOLTAMPERES
TOTAL - VOLTAMPERES
RATIO I_b / I_a

Fig. 8. Curves showing voltampere and impedance relations of delta connected bank

What the delta connection does indicate, however, is the improved regulation as well as the use of conventional methods and the possibility of making certain adjustments, in addition the bank can be used to furnish power for 3-phase loads as well as single phase.

IF HAVING TROUBLE with office woodwork, add glue to water to wash. Glue is an excellent paint cleaner, and its "sizing" quality replaces the gloss which soap and water tends to dim. One half pound of powdered animal glue will clean a medium sized room. Add water to glue to make two quarts of liquid. Let stand over night. Boil this for 10 minutes stirring. Mix cup of this solution with small pan of water when washing paint. Do not rinse off but allow solution to dry on paint.

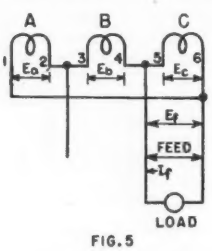


Fig. 5. Delta connection

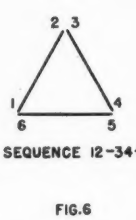


Fig. 6. Phase sequence of delta connection

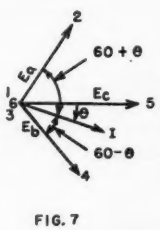


Fig. 7. No load voltage relations of delta connection

PRACTICAL HINTS AND KINKS

Wall Switches

By Thomas Trail

IN REPLACING WALL type lighting switches, always be careful to note exactly how the wires are connected. This is particularly important where a switch has more than two wires connected to it. Failure to take this precaution may result in trouble, and may even produce ludicrous results.

The writer recalls such an instance. In a large hotel a complaint was made to the engineering department that in one of the guest rooms the bath room light would not light at times.

The bath room switch was checked as well as the bath room light and fixture and the room ceiling light also, to determine if any connections were loose or broken, but nothing was found amiss.

Since several guest rooms are fed from each circuit from the floor panelboard, an examination was made of the adjoining room from which the current fed. Here the trouble was discovered.

The room ceiling light switch had been recently replaced, and in connecting the wires to the new switch, the maintenance man had made a mistake. Instead of connecting the wire feeding the bath room light in that and the adjoining room to the "hot" terminal of the switch, it had been connected to the terminal controlled by the switch.

Thus the guest in the adjoining room could only light his bath room light whenever the guest in that room had his room ceiling light lit.

Rereeving a New Wire Rope

WHEN REPLACING an old and worn rope with a new one, on any machine which requires pulling the new rope through blocks, over sheaves and on to drums, here is an idea developed by a wire rope manufacturer.

From the end of the old rope, unlay and remove four of the six strands to a distance of about 2 or 3 ft. Similarly remove 2 of the 6 strands from the new rope to be installed.

Splice, or more properly speaking "lay" the two together and tape the ends to prevent unraveling. This will permit the new cable to be pulled through blocks and pulleys and reeved rapidly, accurately and easily.

This, of course, can be done only with preformed wire rope, since it is only that type of wire rope with strands which will lie inert. To remove the seizing wires and attempt this procedure with non-preformed wire rope would be courting disaster, since ordinary wire rope, so cut, would virtually explode.

Sketch by Chas. W. Parks showing how thermometer case is built for taking coal pile temperatures

Taking Coal Pile Temperatures

By Charles W. Parks

WHERE COAL is stored, whether in large or small amounts, fires are always possible due to spontaneous combustion. For this reason, a constant check on the coal pile temperature affords a reliable means of preventing fires or locating hot spots.

For large storage piles, where coal must stand for some time, ¾-in. pipes are driven in the coal at about 12-ft apart. These pipes are closed at the lower end by forging the end sharp so as to make them easier to drive in. Thermometers are tied to a piece of twine and lowered down into the pipes and left there. When it is desired to take temperatures, all that is necessary is to raise the thermometers and read the temperature. If a certain spot is suspected, an extra pipe is driven at that spot and the temperature taken.

In the accompanying diagram is shown a type of hand thermometer case for use in taking coal pile temperatures. A piece of 1-in. pipe of any required length is cut as at "A". A section "B" is cut away for about 15-in. half way through the pipe. A piece of ½-in. pipe, slightly longer, as at "C", is cut to fit inside the larger pipe. A section of "C" is cut away as at "E" to correspond to "B".

A thermometer "F" is placed in the opening and held by suitable clamps. The relative position of the two pipes are marked at the tops so that when the small pipe is in the larger, the back of "E" will be turned so as to close up the opening "B", thereby

Measuring Insulation Resistance

An important part of preventive maintenance is the periodic measurement of the insulation resistance of electrical machinery. Since electrical insulating materials are nonconductors only when dry and clean it is important to keep all equipment dry and clean as accumulation of dust and dirt not only contribute to insulation breakdown, but they operate to increase motor and generator temperature through restriction of ventilation

protecting the thermometer from being broken while it is being pushed in and out of the coal pile. Handles are provided at "D" and "G" for manipulating the instrument. The pipe is painted its entire length and marked off in feet.

With the opening at "B" closed, the pipe is thrust into the pile at the desired spot and the handle "D" turned ½ turn. After suitable time has been allowed for the thermometer to adjust itself to the correct temperature, the handle is then turned back ½ turn and the pipe withdrawn, after which handle "D" is again turned ½ turn, thereby exposing the thermometer so that the temperature may be read.

The big advantage of the instrument is that it can be used in any position or at any angle, as into the side of a pile. By noting how far the instrument was pushed in, the exact location of a hot spot may be determined. Indicating thermometers or recorders, using long tubes, can be substituted for the regular thermometers and the instrument mounted on top of the pipe if desired.

FOR THE TURBINE OPERATOR

Turbine Inspections

By John F. Slavinsky

FOR YEARS we have been in the habit religiously of taking our two steam driven turbo-generators apart for annual cleaning and inspection. Due to pressing business orders we were forced to operate two years before we had an opportunity to open up our 780-kva turbo-generator and turbine for inspection. This turbine is a non-condensing machine operated at 200 psi steam pressure, 90 F superheated steam and exhausting at 10 psi into the mill process exhaust steam line.

When we lifted the upper half of the turbine casing we were rather surprised to find that the turbine rotor blading tips were highly polished and some of the blading tips were slightly bent outward.

After a thorough inspection to determine the cause of this condition we found that the casing liners between the stationary blades were warped; hence the high spots and consequent rubbing of the rotor blades.

Getting together with the turbine service engineer we decided that due to limited time we were unable to reline the upper half of the casing with new liners so we decided to try our luck in making a repair that would hold out until the next inspection period so that by that time we would have the necessary parts. We decided on a temporary repair to pull up the present liners back to their normal position.

We drilled through the high spots of the liners into the casing and then tapped out for ¼-in. bolt holes. After the tapping operation we used a ¼-in. cap screw to draw the liners back into place against the turbine casing. After removing the cap screw, the liner had a tendency to spring out a little so we countersunk the liner hole and used a flat-head machine screw ¼-in. by ½-in. for pulling the liner into place. While pulling up the liner into place we kept tapping on the liner with a blunt piece of iron rod and a hammer. In this way we were able to get the liner to fit snug against the turbine casing. After making the machine screw up good and tight we had a space of a little less than 1/32-in. over the screw head which we filled up with silver solder.

When the silver soldering operation was over we burred and ground out the high spots of solder with a portable grinding stone even with the liner. It has been 10 months since we made this repair and after operating the machine 24 hr per day, 6 days per week nothing unusual has happened to indicate that the repair did not hold as planned. We expect to renew these liners at our next annual shut down which is due in about two months.

Of course, it may not be practical to do a repair of this kind at higher steam pressures and superheat but in our case with 200 psi steam pressure and 90 F superheat we were able to get away with it very nicely.

Just how long a repair of this kind will hold together is anyone's guess but rather than trust our luck too far we intend to renew those liners at the next shut down.

Check Valve Installation on Back Pressure Line Improves Operation of Condensing Turbine

FOR THE PAST 20 years we were operating our bleeder type condensing turbine and bleeding 10 lb of steam into the back pressure line for processing. During the present war years our tempo of production increased to an extent that the amount of steam bled from the turbine was insufficient to thoroughly dry our product. As the turbine is located quite a distance from the department where most of the bled steam is used for process there was quite a drop in the exhaust pressure at the far end of the exhaust line.

To make up this deficiency in steam pressure where it was urgently needed we installed a 2 in. 125 lb live steam line connecting at the farthest end of the exhaust line with a pressure reducing valve to introduce enough steam into the exhaust line to compensate for the loss of back pressure. We then got into some real trouble here at the power plant.

At times the steam pressure would get too high in the process line due to the pressure regulator acting too sluggishly and the back pressure would build up to a value, 4 or 5 lb higher than that the turbine was being bled at with the result that the vacuum on the turbo condenser would drop from 28 in. Hg to 22 in. Hg resulting in a higher water rate per kw. After making a survey of the existing conditions we decided to install a check valve on the back pressure line near the turbine. Since we installed this check valve we find that our turbine performance is very satisfactory. When the check valve closes due to a higher pressure than that which is bled at the turbine, the condenser handles the slight change very nicely, and the vacuum remains nearly constant at 28 in. Hg.

The Boiler Fireman's Handbook

BECAUSE of illness, the author was unable to complete Part XIX of the handbook in time for this issue. This is to assure his many readers that he expects to have it ready for the next issue.

Clarified

SOMEONE had wired a government bureau asking whether hydrochloric acid could be used to clean a given type of boiler tube. The answer was: "Uncertainties of reactive processes make use of hydrochloric acid undesirable where alkalinity is involved.

The inquirer wrote back, thanking the bureau for the advice, saying that he would use hydrochloric acid. The bureau wired him: "Regrettable decision involves uncertainties. Hydrochloric will produce submuriate invalidating reactions."

Again the man wrote thanking them for their advice, saying that he was glad to know that hydrochloric acid was all right. This time the bureau wired in plain English:

"Hydrochloric acid," said the telegram, "will eat hell out of your tube."

GLUE IMPREGNATED PAPER GASKETS are used today on jeep, tank, and airplane motors. This flexible, easily processed material is said to offer a tight seal, is easily removed, does not flux to metal, and is highly vibration proof.

Twinned Pumps Solve High Pressure Pumping Problem

By Elton Sterrett

When contractor J. A. (Jimmie) Gray, of Houston, Texas, found that he would need to double the amount of high-pressure fluid to get his job done on time, he also learned that no pumps of the desired capacity and working pressure could be obtained under six months' delay, and that even then the deliveries were dependent upon so many factors that his chance of completing his contract within the time limit was out unless some substitute for the standard solution to such pumping problems was developed.

Canvas of the equipment situation showed that two 7¼ by 12 in. duplex pumps, capable of putting up 900 pounds working pressure with 4¼-in. liners, could be obtained. But the problem of hooking both these pumps onto the delivery line brought up the possibility—the grave probability—of setting up periodic superposition of pump impulses when the imposed pressure on the line would be in the neighborhood of 1600 psi instead of the designed maximum of 900 psi. With the 4¼-in. liners, both pumps would put out sufficient fluid to meet maximum demands, leaving only the problem of linking them effectively.

The solution was found by mounting the pumps side-by-side on a single skid, reversing one crankshaft so that the two drive pulleys, instead of being separated by one gear box, were adjacent. When thus mounted, the two sheaves in effect became one large grooved unit, with the space between adjoining rims only slightly more than the width of one of the D-section belts used for the drive.

Fig. 3. The Siamese suction manifold, with the enlarged section at the Tee, provides smooth flow to both sides of the twinned unit, assuring that each suction stroke will obtain full volume of liquid, and aiding in eliminating pulsations due to pump pound against only partially filled cylinders. The discharge lines are connected above the pumps, to accommodate the Tees and risers which absorb inequalities in make-up and setting

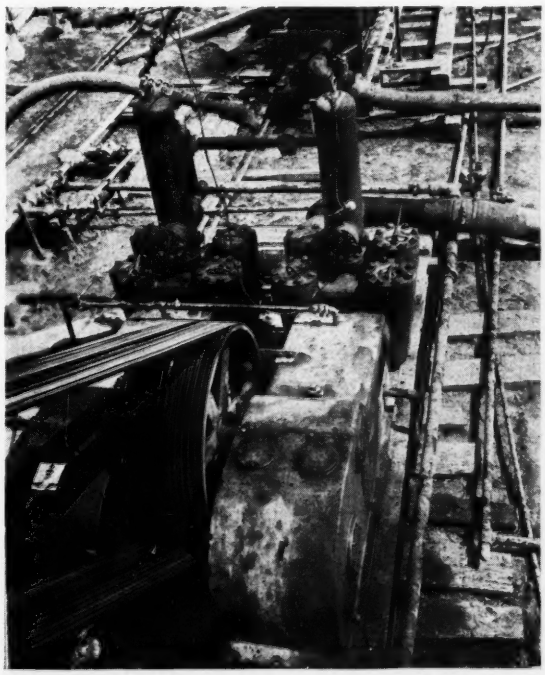


Fig. 1. Two identical pumps, except that one crankshaft has been reversed to bring the drive sheaves adjacent, are mounted on the same skid to make what amounts to an eight-stroke pump, each set of four plungers discharging through a separate manifold and air chamber, after which the streams are combined to give a smooth flow, practically free of serious pulsation

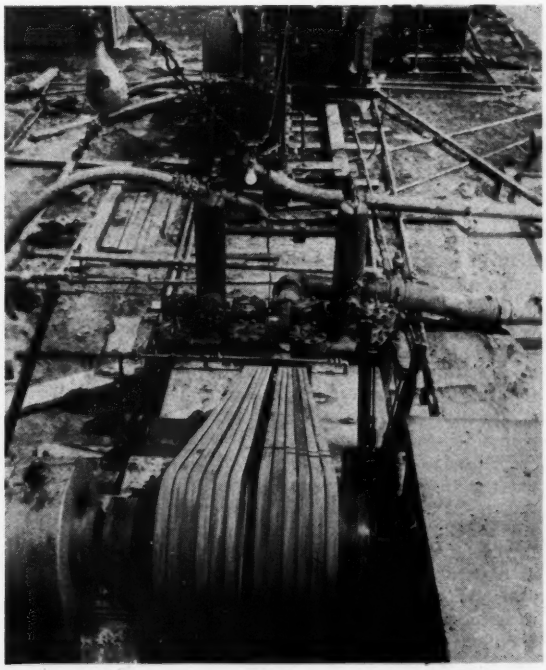


Fig. 2. From the power unit, the two sets of six V-belts appear as a single 12-belt drive—as indeed they are—as the connection between pump shafts insures that the entire driving effort is equably divided between the two pumps in accordance with the load thereon. Twelve belts drive the twinned pumps, whereas 16 would be provided, were the pumps powered separately

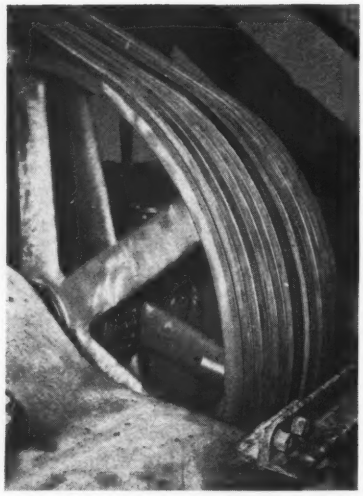


Fig. 4. Taken while the pumps are making 90 spm, this shows the chain-type flexible coupling uniting the two abutting shaft ends. The 2 by 2-in. angle brace ties together two units to prevent possible shifting on the skid, and also to protect against possible backing into the belt drive while working on one of the inner sets of valve covers

To insure that the pumps would remain "in step," once they were set up, halves of a chain-type flexible couplings were mounted on the abutting shaft ends, and the chain set in place over the sprockets, allowing the required amount of play between shafts, but insuring that the two made exactly the same number of revolutions in any given time. Before the keyways were cut for the coupling, the crankshafts were carefully set, by a factory mechanic, so that the pump strokes overlapped ⅛ of a turn. In effect, the four plunger ends of one pump unit were combined with those on the other to form an eight-stroke pump. As a result, the pressure peaks which would occur as the units went out of step were suppressed, and a uniform delivery, even when the two air chambers were cut off, was obtained. With the crank throws of the two pumps adjusted to minimize the pulsation of the delivery, the separate plunger strokes are evident in the line only through a rapid and slight vibration, instead of the heavy pounding usually evident.

To provide suction for the twinned pump, a Siamese connection was made up by the welder, with only a single suction line to the supply pit. A 10-in. Tee of standard design was chosen as basis of the manifold, with a 10 by 6-in. swage welded to each end of the run, and a 10-in. nipple to the side opening. The Tee was connected to the suction line with a quick-acting union, to absorb possible shift in alignment between pump and suction line. To each swage was welded a 6-in. sweep ell carrying a nipple 12 in. in length, on the outer end of which was welded a flange matching those on the pump suctions. The slight amount of clearance afforded by the stud holes in the flanges allowed for slight variation in the dimensions of the unit as welded. To prevent possible spreading of the manifold under vibrations encountered when working under maximum pressures, a tie rod, of 1-in. round steel, was welded across between the two 12-in. long nipples.

The delivery lines were likewise joined at the pump, with a swing connection at each outlet to absorb slight misalignment and permit tightening of any threaded joint which might show signs of leaking.

Normal belt complement for each of the pumps, when driven singly, was usually specified at 8 belts of the section used. When the two pumps were twinned, however, and drive taken from the overhead power countershaft, original calculations that the doubled unit would operate successfully on only 12 belts were justified by operations. Each 6-groove sheave on the pump stub end proved ample to deliver the desired power, check of pump strokes against engine rpm demonstrating that no more than the customary slip occurred.

Careful check of the fluid delivered indicated that the expected gain of 25 per cent over deliveries if the two pumps had operated independently was surpassed. Several check runs showed that the delivery gain amounted to approximately 40 per cent while V-belt life, even with the reduced number of units in the drive, greatly exceeded that on the standard pump set-up.

In case of repairs being indicated to either side of the twinned pump, it was necessary only to close the discharge gate on that side; after stopping the drive long enough to remove the V-belts on the side to go down, and to remove the chain from the flexible coupling. Registry marks on the halves of the coupling enabled the original balanced stroke set-up to be regained when again coupling the shafts—all without going in to the pump to check crank throw positions.

The twinned pump was moved as a single unit, simply by removing the belt drive and breaking unions in suction and discharge lines.

Characteristics of Electric Controllers

By H. D. JAMES

CONTROLLERS for electric motors consist largely of switches and relays. The switches can be operated either manually or magnetically; they connect the motor to the power supply to operate it and disconnect the power to stop it. Other switches are used for reversing the motor and for automatic acceleration. Resistors are used for limiting the current at starting and for speed regulation. The relays afford protection against accidental conditions. The most common types protect against overload and unexpected starting. Relays are also used to control acceleration and to perform other functions. There are over twenty-five different types of relays available for motor applications but only two or three are required for general use.

The controller should be inclosed or otherwise protected from accidental contact by persons or the burning of persons when arcing occurs. Manual controllers should be designed to give satisfactory protection to the operator. Magnetic controllers are usually remote from the operator and actuated by push buttons or some form of master switch which is inclosed and handles very little power. Motor starters are usually of the magnetic switch type operated by push buttons.

1. Controllers for *Squirrel Cage Induction Motors* are usually called starters and consist of a magnetic switch for connecting the motor to the power supply and a thermal overload relay. A single contact closes this switch, such as a push button, a float or pressure switch, a thermostat or a time switch. It is the simplest possible type of controller for any motor and will last for years with little maintenance.

Larger motors require reduced voltage starting. This controller has two switches, a starting and a running switch—means for obtaining the reduced voltage and a relay to change the connections from the starting to the running position when the motor reaches the necessary speed. A thermal overload relay is also necessary.

2. Controllers for *Wound Secondary A-C Motors* require a primary switch, such as described above for starting the Squirrel Cage Motor at full voltage and switching means for changing the resistance in the motor secondary winding. This latter is often a drum controller with auxiliary contacts for actuating the primary switch. When the motor is reversed, primary switches are used.

3. Controllers for *Synchronous Motors* are more complicated. They

are started like a Squirrel Cage induction motor and have, in addition, switches and relays to control the field circuits during acceleration and when synchronizing. The operation of the field control is complicated and can best be performed automatically. It is important to synchronize when the primary and secondary poles are in the correct relative position to prevent a heavy current inrush. Several types of relays are available for this purpose. A field rheostat is provided for adjusting the strength of the motor field to obtain the desired power-factor.

4. *D-C Shunt Motor Control* includes a resistor to limit the current when starting and sometimes for speed regulation. In starting, this resistor is short circuited in sections, usually by automatic means. The motor is started by closing a line switch which is opened by a relay when an overload occurs. The field winding stores up magnetic energy that must be discharged when the winding is opened. Non-reversing motors have the field winding connected so that it discharges through the motor armature. Reversing motors have both sides of the armature disconnected by the controller in a way that prevents discharging the field through the armature. The field winding, therefore, has a non-inductive resistor connected permanently in parallel with it to absorb the discharge and prevent an excessive voltage rise across the windings. Persons can get a severe shock when the field winding is opened and must use care in handling it.

5. *D-C Series Motors* have controllers similar to D-C Shunt motors except that the field winding consists of a few turns of heavy wire in series with the armature and requires no special care in handling it. The resistor in the armature circuit is usually shortcircuited in steps by manual means instead of automatically.

Many of these motors are used for hoists or cranes; they have the brake magnet winding in series with the armature and it is usually connected to one field terminal.

6. *D-C Compound Wound Motors* use either shunt or series motor controllers for most applications, with connections for the extra field if necessary. Some applications use a special control arrangement to connect the compound winding in circuit. For example, one part of the compound winding may be used for only one direction of rotation or only for certain load conditions.

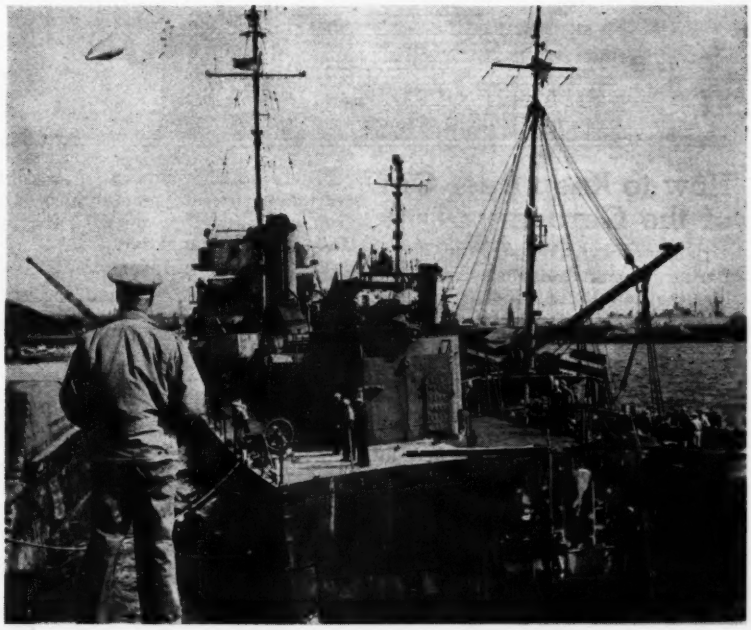
Starters are a type of controller that has just one function, i.e.: to connect the motor to the power supply and bring it up to full speed. Nearly all Squirrel Cage motors use starters. Standard controllers of various types are listed with the motors to which they apply and are not hard to select when the correct motor is chosen. Machinery and other motor driven equipment is sold with the correct motor and controller for its successful operation. In the few cases where there is a choice of the type of controller, expert advice may be necessary.

The application may require a splash proof motor and controller or a submersible type. Some locations require explosion proof equipment, which comes under several classes depending upon the type of exposure. High altitudes increase arc rupturing difficulties and may require a special design of controllers. Controllers above the 2200-v. class should be applied by experienced persons who can check the rupturing capacity and the protection necessary against lightning surges.

Oil immersed control is available for a-c motors and is desirable in dirty or dusty places, also where there is corrosive gas in the air or where the air contains combustive material.

The person operating the controller usually has other important duties to perform. Therefore its operation should require the minimum attention. Its arc rupturing parts require inspection and maintenance; they should therefore be readily accessible. Contacts and current carrying joinnts should be plated to prevent oxidation, which will cause local heating. A thin film of vaseline in the joint will exclude the air and reduce oxidation. Motor driven equipment should be purchased with the motor and controller mounted integral with it and wired up ready to connect to the power lines. The branch circuit wires should be protected by a circuit breaker with a time delay overload trip, where they are connected to the power feeders to protect these wires. Each motor controller will have its own thermal overload protection, which should operate before the circuit breaker opens. Several motors may be connected to a branch circuit.

Controller diagrams consist of lines representing wires and symbols indicating controller contacts, coils, and other parts. With a little practice, the ordinary controller diagram can be readily understood. The controller salesman or some other experienced person can help the beginner to understand it. Elevator controllers and some other complicated types are difficult to understand. Many of them require expert training to adjust and maintain. Understanding a controller diagram usually requires memorizing the circuits and the functions of each piece of equipment. This is easily done when there are only one or two contractors and an overload relay, but some controllers have twenty-five or more elements whose operation and functions take time to understand. In addition to its elements, an automatic controller makes use of cer-



(U. S. Navy Photo from Acme)

Crippled DE Supplies Power for City

France—During the critical days after the Normandy Invasion, the destroyer-escort USS Donnell, which had her fantail blown off by a Nazi torpedo, furnished electric power for the City of Cherbourg—deprived of its power plant by German demolition squads. The Donnell was towed to a British Port, stripped of much of its deck equipment, and then transferred to Cherbourg. With the help of a captured German transformer, the lights in the French City were turned on again. Here, the warship, minus her stern, is shown tied up at Cherbourg.

tain principles of methods of operation that tie these elements into an operating whole.

For example, the motor acceleration may be governed by a time element, a current limit, or other means for adjusting the current during acceleration. Other elements may regulate the speed during deceleration and stopping.

Even the most experienced engineer cannot grasp the various functions of a controller from an unfamiliar diagram without considerable study. Reading a diagram takes time and usually some help so that no one should be discouraged with their initial efforts. Manufacturers supply instruction books and other material with the more complicated controllers to help in understanding them. Motors have many different parts but they are assembled together mechanically into rigid units. Brushes, when used, are the only parts that require adjustment and renewal. Controllers have their parts in separate units and some of them need attention. The arcing contacts must be cleaned and renewed, some relays need adjustment. To maintain them requires an understanding of the functioning of many parts. A similar detailed understanding is not required of the motor.

Controllers present many interesting engineering problems, such as arc rupturing, types of contacts, methods of control, etc. These problems are not difficult to understand if given a little study. There are several books available that are descriptive and use very little mathematics. An operating man will recognize from his own experience many of the points described and will be glad to have them explained.

LETTERS AND COMMENTS

How to Keep Deer Out of the Garden

I CAN'T WRITE poetry like Art Parker (thank God) but here is an idea that may solve the deer problem.

A genius like Parker should have no trouble in rigging this scheme up. What do you think?

The principle difficulty in installing an electric fence around a garden is, I gather, to make the deer jump away from the garden when shocked instead of towards it. This device might work (See diagram).

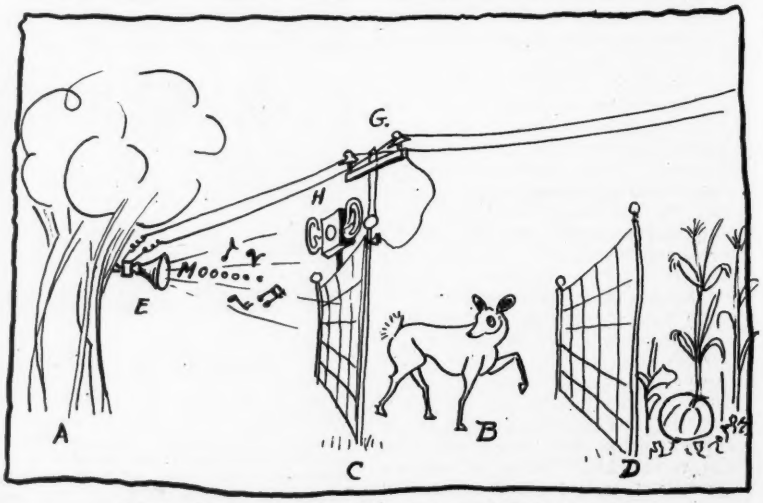
Deer B comes from the Woods A, and jumps fence C. This sets off deer call E, before deer has a chance to jump second fence D, into garden F.

Deer turns around to see who called her (or him) and goes back to poke nose through fence C. In the meantime, however, audio relay H, has picked up the deer call and has charged fence C electrically. So, when deer B touches fence C, she (or he) is facing away from garden F, and jumps towards woods A, thus saving garden F from destruction.

There are a number of possible variations to this general idea. Did you ever hear the story of the old lady and the kangaroo?

Inventively

Boston, Mass. SPIKE ALLEN.



Showing how to keep the pesky deer out of Parker's garden

A Simple Test for Substandard Coals

AT INFREQUENT INTERVALS, analysis of a coal shipment reveals a below normal figure for ash free—moisture free heating value (H Value) usually accompanied by a rather high moisture content. While such coals are usually called "crop coal," it is not certain whether this substandard state is due to weathering, or that due to geological circumstances, coalification has not been completed. Such coals at best cause a substantial increase in the consumers fuel bill and at times may affect the load carrying capacity of the boilers.

A simple test has recently been encountered which apparently permits easy and rapid detection of such coals. A few small pieces of the coal about the size of a pea are placed in a beaker and sufficient concentrated ammonium hydroxide is poured in to cover the pieces of coal. Sub-standard coal causes a distinct brown color to develop in the ammonia solution, while normal coal develops no color except perhaps a turbid gray due to suspended coal particles. The test appears to be very sensitive, since in a washed coal which normally has a very consistent H value, deficiencies of only 100 Btu in H value cause a distinct brown color.

The test as developed in the Indianapolis Power & Light Co. laboratory has only been used as a qualitative check. While a quantitative test might be based upon this reaction, it seems doubtful whether it would be much simpler than the usual calorimeter determination.

Such limited testing as has been done, indicates that this test does not show up the drop in H value which is usually found in coal that has been stored in the open for several years.

Experience with this test has been limited to a few strip mines in the

REPAIRS SPEEDED

DOWNTIME REDUCED

COSTS CUT . . .

by LUNKENHEIMER

Interchangeable Parts

Maintenance men find their job made easier and operating efficiency stepped up by Lunkenheimer interchangeablity of parts.

In servicing the Bronze "Renewo" and Iron Body "Ferrenewo" Valves—both regular and plug types—only *one stock of parts* is required. *All* parts (except bodies and bonnet rings) are made exactly the same and fit each other perfectly.

Repairs are more quickly and easily made, ordering and handling are simplified. The result: Lower maintenance cost and low ultimate valve cost.

Lunkenheimer part-interchangeability is fully illustrated and described in Circular No. 567. Ask your Lunkenheimer Distributor for a copy, or write direct.

BRONZE
200 lb. S. P.
"RENEWO"

IRON BODY
150 lb. S. P.
"FERRENEWO"

VALVE MAINTENANCE SIMPLIFIED!

All parts of these valves (except bodies and bonnet rings) are exactly the same. They fit each other perfectly.

For example—if you need a stem, disc, or seat ring for the "RENEWO", you can use the corresponding part of the "FERRENEWO", and vice versa.

Thus there are fewer parts to be carried, repairs are more quickly and easily made. The labor, time, and expense of valve maintenance is cut down—'way down!

SEE YOUR LUNKENHEIMER DISTRIBUTOR!

Lunkenheimer Distributors are located in all industrial centers. There is one near you—have him demonstrate with actual samples the interchangeability of parts in "RENEWO" and "FERRENEWO" Valves. It's a big time and money saver for any plant!

• SAVE THIS WAY, TOO! •

For severe throttling service, a regular type can be converted into a plug type, by simply changing the seat and disc, without taking the valve out of the line.

Thus it's not necessary to buy a whole new valve—just a matched set of plug type seat and disc which interchange perfectly in corresponding patterns and sizes in a range of pressures from 150 to 350 lb. S. P.

Lunkenheimer simplicity of design, minimum number of parts, and fine precision workmanship make this and other outstanding economies possible.

Fig. 16
300 lb. S. P.
Bronze "RENEWO"

Fig. 16-P
300 lb. S. P.
Bronze Plug Type
"RENEWO"

THE LUNKENHEIMER CO., Cincinnati 14, Ohio
(OFFICES: NEW YORK 13, CHICAGO 6, BOSTON 10, PHILADELPHIA 7.
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Southern Indiana field. Since theory points to a reaction between the humic acids in the coal and the alkaline ammonia solution as a cause for the brown discoloration, it may be that the test would have general application to other mines and other coal fields.

R. W. GAUSMANN.
Indianapolis Power & Light Co.

How to Test Water in the Boiler Room

I HAVE READ with interest the article on this subject by E. O. Davis in the November, 1945, issue. While I believe the material therein contained should prove of great value to many engineers who are aware of the necessity of accurate feedwater control through chemical conditioning, however, I must take issue with Mr. Davis on one statement which he made in his article in the section entitled, "How to Interpret Your Tests."

On page 77 Mr. Davis states that for internal treatment the H reading (measure of soap hardness in the water) should be maintained between 0.1 and 0.5 grains per gallon or 1.7 and 8.5 parts per million.

If Mr. Davis will look into the theory of phosphate conditioning of boiler water, he will find that in water which has been properly conditioned internally and which has a phosphate concentration of from 40 to 60 parts per million of phosphate, the hardness will be zero. The prevention of scale in a boiler is dependent upon the maintenance of this phosphate concentration in the boiler water at all times.

While I will acknowledge that the soap test is of inestimable value as a check on softener operation, it has no place in the test procedure for internal conditioning, for if by means of a phosphate test we determine that the phosphate concentration is above 40 ppm we know immediately that the hardness in the water is zero and that no scale is being formed in the boiler drum or tubes. In this instance, a soap hardness test will tell us nothing that has not been ascertained by means of the phosphate test.

URBAN C. FLEMING, JR.
City of Holyoke, Mass.
Gas and Electric Department

The foregoing was transmitted to Mr. Davis, who replied as follows:

Dear Mr. Fleming:

Many thanks for your letter to POWER PLANT ENGINEERING. I hope they receive a lot of them, as that kind of letter, I believe, will get the engineers on their toes.

Your criticism of my How to Interpret Your Tests is correct. With free phosphate in the boiler, the soap test is not used. As I stated, you will require a phosphate comparator. From your letter I take it that you are a firm believer in free phosphate in the boiler. I am sure you have a lot of friends of the same thought and I am one of them, although it still holds true that a boiler can be kept free of scale without free phosphate in the boiler.

A few years back, I had charge of a plant for a dye house, where nearly all the steam was used directly in the dye vats to heat the dye water. Any trace of soda ash was sure trouble, as it did not look well on black goods. The dye house used acid phosphate with their dye water, so I started to use it after the soda ash, which was used in the small makeup tank. Acid phosphate was dissolved and fed just ahead of the boiler feed pump. The boiler water was held between 0.1 and 0.5 gpg H and between 18 and 26 gpg M. The boiler had no scale and was never opened except for inspection by insurance and city inspectors. The insurance inspector told the superintendent that he had never seen a boiler in better shape.

Chicago, Illinois E. O. DAVIS

Two Letters from Oak Ridge

I EXTEND YOU compliments from the heart of the atomic bomb industry on your very excellent series of articles on the subject.

During my fifty odd years on this planet I thought I had pretty well run the complete list of accidents peculiar to power plants yet today it was my unpleasant task to investigate a new one, that of a coal handling plant laborer who lost the sight of both eyes and the use of his hands.

This man discovered two small, brightly colored tin cans in the scrap picked off the belt by the magnetic separator. On opening them he discovered one to be full of bright shiny copper tubes and the second to contain 2/3 that many. Yet these were not so shiny bright but had encrustations of some pale yellow crystals on them. When he rubbed all the group in his hands to free them of the foreign matter an explosion occured that caused the above mentioned injuries and which was distinctly heard and felt throughout the noisy plant.

Of course, the fuse type blasting caps originated in the producing mine and had been effectively intercepted by the Dings' Magnetic Separator, only to be picked up by an inquisitive Negro workman. The second can had a dented cover which permitted air to enter and cause the loosened high explosive to form crystals contaminated by copper salts to adhere to the copper shells. This contamination probably caused the explosive to become even more sensitive and less stable than usual. Hence the action of rubbing the shells together, perhaps in conjunction with some grit on the fingers, caused the initiating explosion. This in turn fired the caps not affected by the corrosion. Each container could hold ten caps.

What this wholly unforseen accident has done to our accident record in the closing month of the year can be imagined. All we can say is, "There's one for the "Book" or Ripley!"

PAUL C. ZIEMKE.
Safety Engineer
Oak Ridge, Tenn.

REFERRING TO MY recent letter concerning the accident perhaps there is still time to add that plant changes will discharge all refuse into a sealed hopper from which it will be drawn off into covered trucks for disposal in a permanent swamp. Plant personnel will also be given the benefit of demonstrations and lectures on the identification and proper safe handling of any suspicious materials since these may also be found ahead of the magnet in some cases.

PAUL C. ZIEMKE.
Safety Engineer
Oak Ridge, Tenn.

Training of Practical Engineers

November 19, 1945.

I READ Mr. Mosher's article "Training of Practical Engineers" in your October issue with great interest. Before entering military service, I had been involved in power plant vocational training to a limited extent.

As an ordnance officer in the army, it was my duty to supervise the technical training of men with a great variety of educational backgrounds. I found the army training films to be of inestimatible value in this work.

I believe that similar films would be of great value to supplement textbooks for power plant instruction. I am thinking principally of the animated drawing type of film, preferably in color. These could be adapted to any piece of power plant equipment and would have more instructional value than hours of reading or explanation.

The films could be prepared and distributed under the direction of a national organization such as the Edison Electric Institute. Perhaps manufacturers could be induced to make them for the advertising value they would have. Distribution could be through the Edison Electric Institute or direct from the manufacturer.

There may be films of this type available now. If so, I do not know about them. I would appreciate any information that anyone may have on the subject or any comments.

JAMES D. WILLIAMSON

PAPER CANS with a lining of plasticized glue have been used successfully as a container for motor oil.

JUST SAY CRANE . . .

For Everything In Piping Materials

For this typical 2-boiler hook-up, for example—from boiler outlets to headers to steam service lines—all the piping materials are available from Crane. All the valves, fittings, fabricated piping, pipe, and piping accessories can be secured—on one single order—from your Crane Branch or Wholesaler.

Whether you need piping equipment for power or process lines, for moderate or severe working conditions, selecting it from the complete Crane line gives you this three-way advantage:

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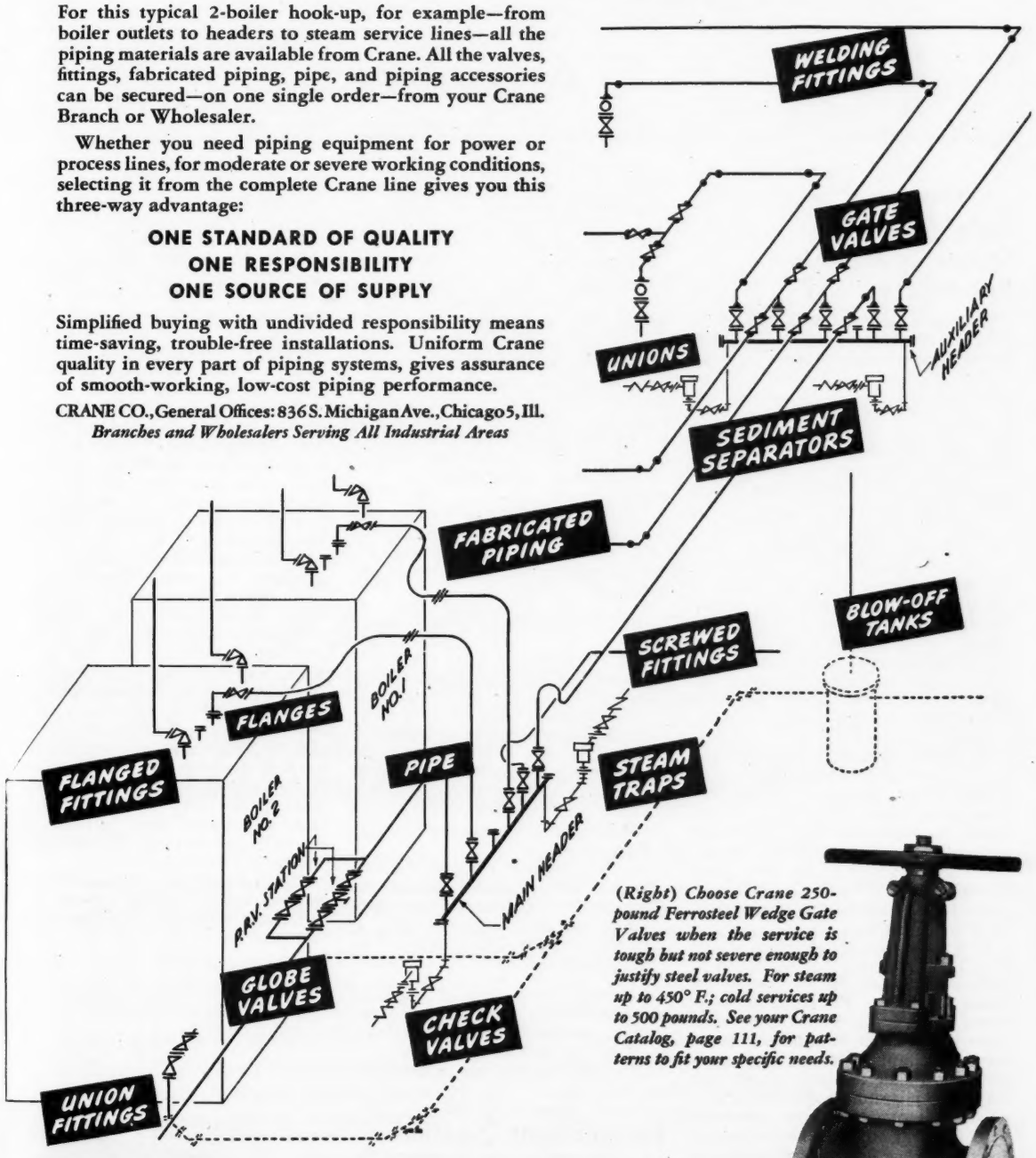

(Right) Choose Crane 250-pound Ferrosteel Wedge Gate Valves when the service is tough but not severe enough to justify steel valves. For steam up to 450° F.; cold services up to 500 pounds. See your Crane Catalog, page 111, for patterns to fit your specific needs.

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CRANE

FOR EVERY PIPING SYSTEM

Questions And Answers

Question No. 321

A Re-incarnation of Question No. 286

Help! Help! How Is Steam Released in Fire-tube Boilers?

THIS QUESTION was originally published in the January, 1945, issue of Power Plant Engineering.

The net result of what has transpired in connection with this matter is that we truly have nothing enlightening on the subject although through no fault of yours, since you have been very helpful and have exerted considerable effort. But I still need a good answer to this question.

In the field of steam generation, I am primarily interested in all types of fire-tube boilers under 500 hp and 300 psi pressure. Particularly am I interested in the typical HRT boiler and the Scotch internally-fired boiler.

How can I get some data on fire-tube boilers similar in nature to that applying to water-ture boilers, as given by Max H. Kuhner of the Riley Stoker Corp. in his article entitled, "How Steam is Released in Water-Tube Boiler Drums," which appeared in the September, 1944, issue?

Specifically, the question is: Just what takes place when steam is released through and from the water surface of fire tube boilers? That is, just how does this action take place in comparison with similar action in water-tube boiler drums, as discussed by Mr. Kuhner?

It is true that information of the type I am requesting is contained in various textbooks on the subject of steam generation. But all of the textbooks I have run across have been quite old and the information I desire would be that obtained from experiments made in recent years with fire tube boilers of modern design, at maximum rates of firing primarily with gas and oil, with the minimum amount of heating surface consistent with good overall efficiency.

Previously, I stressed the fact that this information was of interest primarily in connection with HRT boilers, but since then this same matter has become of equal importance in connection with the Scotch type boiler and similar information on this type of internally-fired boiler would be equally appreciated.

Since the internal circulation in the HRT boiler and the Scotch boiler is considerably different, any information on the release of steam in these boilers would have to take this into particular account.

Los Angeles, Calif. C. C. S.

Question No. 322

What Is Specific Heat of Soapstone?

WE NEED some data on the specific heat of refractories, especially soapstone as used for lining furnaces in the pulp industry. Also we would like to have data on the heat transfer through these refractories.

Seattle, Wash. W. T. B.

Editor's Note—Data covering the types of refractories most commonly used in boiler furnaces and other industrial applications are given in the following:

Marks' Handbook—4th Edition—page 761

Kent's Handbook, Vol. III (Design & Shop Practice)—pages 5-03 to 5-20

Eshbach—Handbook of Engineering Fundamentals—page 12-20

Bulletin R-2-E—Insulating Firebrick —The Babcock & Wilcox Co.

ASTM Standards on Refractory Materials

ASTM—Recommended Procedure for Calculating Heat Losses Through Furnace Walls

Heat Transmission Through Furnace Walls—Atlas Lumnite Cement Co.

Elements of Heat Transfer and Insulation—by Max Jacob and Geo. A. Hawkins; Heat Transmission — by Wm. H. McAdams

References to the use of soapstone as a refractory material are very meager, however, and we shall appreciate any data on this subject that readers care to send for transmission to W. T. B.

Question No. 323

Steam Engine Questions

1. How would you determine the diameter and weight of a flywheel on a steam engine?

2. Why is the first half of the stroke of the piston from the head end of an engine accompanied by *less* than ¼ of a revolution of the flywheel and the first half of the stroke from the crank end accompanied by *more* than ¼ revolution of the flywheel?

Spring Valley, Ill. J. L. P.

Question No. 324

How Do Automobile Wood Gas Generators Work?

WHILE I WAS in Italy I saw and was told that the automotive vehicle engines were propelled by a gas which was made from wood and a chemical, in a liquid form. When the liquid chemical and wood came together they created a gas which was used to propel the engine.

What is the name of the liquid that the people in Europe used and the chemical formula of the liquid?

How was the tank constructed on the inside where the wood and chemical liquid were put in?

J. B.

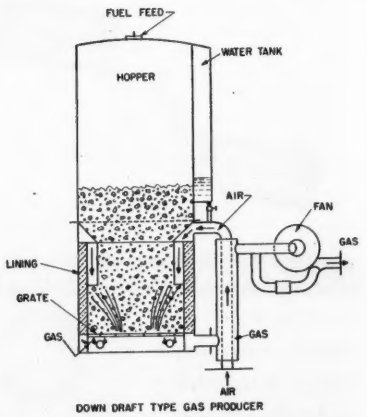
Perhaps you are thinking of the vehicles which operate on producer gas generated by units burning wood, charcoal, coke, or other solid fuels. These units were usually installed in the rear of the vehicle on the trunk rack, although they were sometimes placed on the sides.

The producer gas, which is a mixture of carbon monoxide and hydrogen, is generated by passing a supply of air which is insufficient for complete combustion through the fuel bed. Steam or water is simultaneously passed through to produce hydrogen. The formation of hydrogen absorbs heat, thus preventing excessive temperatures and clinker formation.

There are three types of producers which embody the same principles with only minor differences in construction. They are the up draft, down draft and cross draft types. The down draft type is illustrated here.

We were unable to find any information on the chemical you mentioned, but perhaps it was a catalyst to speed the reaction. Information on Italian producer gas units is sadly lacking, so there may possibly be such a chemical that is not mentioned in American and British references.

The London bus system experimented with a trailer drawn producer and made the following observations:



Producer gas unit for automobiles

Simple, positive, modern

BECAUSE IT'S

Electrical

HAYS AUTOMATIC COMBUSTION CONTROL

Just as more and more industrial equipment items are being electrically driven—stokers, pulverizers, fans, blowers and the like—so is it practical good sense to operate an automatic combustion control system electrically. Thus are utilized the advantages of simplicity, speed and dependability inherent in this fool-proof modern method.

Hays Centralized Control is wholly electrical—with enclosed mercury switches for the sensitive contacts; no moisture, no dust, no other foreign material to cause sticking, chattering and excessive wear. Installation is easy, maintenance is simplified. Adjustments are made direct—not dependent on air pressures, oil pressures and numerous valve mechanisms characteristic of non-electrical designs.

For full details concerning this Method of Tomorrow, send for Bulletin 46-605—contains schematic drawings of 14 typical installations. Write for it.

HAYS *Automatic* COMBUSTION CONTROL

THE HAYS CORPORATION • MICHIGAN CITY, INDIANA

The estimated fuel mileage on specially graded coke was one mile to 2.5 to 3.0 pounds of coke.

There was no noticeable slowing up of speed in starting up after stopping, nor was the running less smooth than with the ordinary gasoline engine.

There was a definite loss of power on hills and grades.

In England, the use of producer gas units resulted in a substantial saving of money. A four ton truck went sixty miles on a bag of charcoal which cost approximately fifty cents, while gasoline for the same distance would have cost approximately three dollars.

References

The Engineering Journal, Canada, April, 1942, "Producer Gas for Motor Transport," by E. A. Allcut, M.E.I.C.

Mechanical Engineering, February, 1942.

The Transport World, London, June 11, 1942.

Answer No. 304

How About a Corliss With Three Eccentrics?

His Engine Formerly Had Three, Says Grace

AN ENGINE in our plant was built to run with three eccentrics. The engine is a tandem compound, non-releasing-valve-gear Hamilton Corliss. The third eccentric operated the low-pressure admission valves. This third eccentric was taken off, however, and both high and low admission valves are operated from the same eccentric.

EDW. J. GRACE.

Bridgeport, Conn.

Answer No. 313

Can This Boiler Be Changed to Give Dryer Steam?

Install a Dry Pipe in Drum, Says Parks

E. O. D. does not mention any form of dry pipe in his boiler but it is reasonable to assume that he has one. Boilers operating at high rates usually require some form of dry pipe or dryer to assure dry steam. If E. O. D. does not have any form of dry pipe and has a fluctuating water level, he is sure to get wet steam. I would suggest for him to change to some other form of feedwater regulator that will carry a more stable water level.

I have made up a rough sketch of the dryer and screen used in our boiler. This was taken from memory and may not be entirely correct as to details but it is presented to give the idea.

The sketch shows the following: The steam outlet at "A"—the steaming tubes at "B"—the water trough at "C"—the steam scrubber at "D"—the steam screen at "E"—and the normal water level at "F".

The steam follows the course of the arrows. Steam enters the drum and passes through the steam scrubber at "D". The water entering the trough at "C" overflows over the sawtooth edge and falls down over the steam coming through the small holes drilled in the cast iron sections of the scrubber, thereby washing it. The steam then passes over and through the steam screen at "E." As it passes through the diamond-shaped openings of the screen, the water or moisture is removed and the dry steam travels up over the baffle and out of the opening at "A."

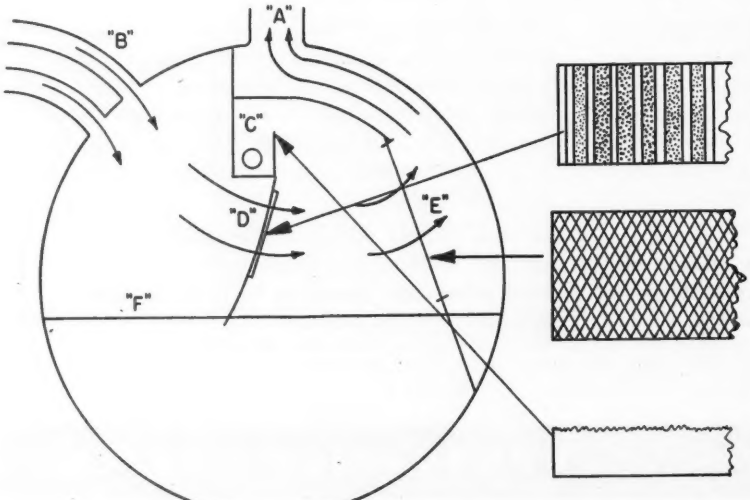
Approximate shapes and appearance of the screen and scrubber are shown at the side sketches.

These boilers are of the 4-drum, cross-drum bent-tube type rated at 1000 hp and working at 160 psi. The sketch shows the rear drum. The water enters the drum at both ends and the feed pipe is led to the trough at both ends. The boilers are equipped with Copes feedwater regulators and the water enters the boiler at about 235 F. The water is treated with phosphate, caustic soda, tannin and sodium sulphite.

The scrubber in the above sketch is drilled with about $\frac{1}{16}$-in. holes and the screen has diamond-shaped openings. Naturally, the total cross-sectional area of the openings both in the scrubber and the screen must be such that all steam generated at maximum ratings will be passed through both the scrubber and screen.

CHAS. W. PARKS.

Baltimore, Md.



Sketch by C. W. Parks of steam drum internals of his boilers, suggested to help E. O. D.'s boiler make dryer steam

Answer No. 312

What Happens When Air and Water Meet?

How Law of Partial Pressures Is Used

HHL'S QUESTION on humidity is a common one and not too simply answered. The answer is based on the "Law of Partial Pressures" which states that the vapors of non-miscible (that is non-mixable) liquids will fill a container completely and will exert a pressure equal to its own vapor pressure and the total pressure in the container will be the sum of all the partial pressures.

For an example, assume that propane and butane were not miscible and enough of each were pumped into an evacuated vessel to fill the vessel with vapors at 70 F. The total pressure would be 171 psi abs but the vapor pressure of the propane would be 125 psi abs and the butane 46 psi abs. Had the container been full of air at atmospheric pressure at the start, the final pressure would then have been 14.7 plus 125 plus 46 or 185.7 psi abs.

If water were injected into an evacuated vessel and brought up to 70 F, the pressure would be 0.3631 psi abs. Had the container been full of air at atmospheric pressure at the start, the final pressure would have been 14.7 plus 0.3631 or 15.0631 psi abs. But the atmosphere is not enclosed and, instead of having a pressure rise, there is a displacement of enough volume to reduce the pressure back to normal. Since water vapor is only about 0.6 as heavy as air there is a reduction in the density of the mixture.

One table from a reference gives:

One lb of air at 70 F, 14.7 psi abs occupies 13.35 cu ft

One lb of dry air with enough water vapor added to saturate occupies 13.69 cu ft

Pounds of water vapor to saturate one pound of dry air equals 0.01578 lb

So the pound of air plus the 0.01578 lb of water vapor occupy 13.69 cu ft at 70 F and 14.7 psi abs, giving a density of 0.0742 lb per cu ft. A pound of dry air occupies 13.35 cu ft giving a density of 0.0749 lb per cu ft.

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Foster Type 38-SV Super-Jet Safety Valve for pressures from 400 to 3000 pounds at temperatures up to 1000° F.

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The problem was approached with a thorough understanding of the factors involved — *plus* — a good healthy dissatisfaction with the shortcomings and limitations of conventional safety valves. As a result, the design of the new Foster 38-SV is revolutionary and its performance characteristics are phenomenal.

A few of the advances: constant popping point regardless of changes in temperature; full opening practically instantaneous with less than ½% accumulation; tight closing as little as 1% below popping point; blowdown adjustable as low as 1%.

Since the first installation early in 1940, more than 100 Foster 38-SV Safety Valves have been working at pressures up to 2575 pounds and at temperatures up to 1000° F. And during the war, all we could make went into installations vital to the war effort.

NOTE:
Now Foster 38-SV Safety Valves are available to Industry again, and Bulletin 25, describing them, will be sent promptly on request.

FOSTER ENGINEERING *Company*

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

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This shows the actual density of the mixture of saturated air is about one per cent less than for air alone at the same temperature and pressure. Most of the time there is not sufficient water source to completely saturate the air at the existing temperature. The ratio of the moisture actually in the air to the theoretical amount is called the "Relative Humidity." Thus a given volume of air with 50 per cent relative humidity is heavier than the same volume of air at 100 per cent but is lighter than air at 25 per cent if all the temperatures are the same.

This account kept away from grains, etc., in order that the values could be checked on common steam tables. The use of grains is of value only in as much as decimals are avoided, but in all air conditioning calculations it is just as convenient to use pounds from the start.

Houston, Tex. BILL MADDOCK.

When a Pound Is Not a Pound

TO HELP clear up H. H. L.'s question we will first correct several misunderstandings.

It is true that water in the solid or liquid state is heavier than air, but in the vapor state the opposite is true, under the same volume and temperature conditions.

H. H. L. states that 1 lb of air at 70 F dry bulb and 70 F wet bulb and 29.92 barometer will be capable of holding 110 grains of moisture. This would be a supersaturated mixture having a total weight of 1 lb. It would not hold 110 grains of moisture, because the original weight of dry air, available to start with to cause this mixture of 1 lb total weight, would be less than 1 lb. But 1 lb of air is the amount of dry air at 70 F and 29.92 barometer necessary to evaporate 110.3 grains of moisture, resulting in a saturated mixture of 7000 grains plus 110.3 or 7110.3 grains. The wet bulb temperature would be 70 F and relative humidity 100 per cent. The volume of this mixture would increase to 13.69 cu. ft. (From Kent)

Due to the above corrections, 110 grains would not be subtracted from 7000 grains (1 lb) to determine the other quantity which is the air itself, as H. H. L. did in arriving at 6890 grains. Instead it would be subtracted from the 7110 leaving 7000 grains the weight of dry air necessary to hold or evaporate 110.3 grains of moisture at 70 F and 29.92 barometer.

St. Louis, Mo. JESSE L. ERISMAN

They Mix, Says Ruppright

PERMIT ME to answer the question What Happens When Air and Moisture Meet?

They mix.

One pound of air, only air, i.e., 0.7547 lb of nitrogen, 0.2319 lb of oxygen, 0.0004 lb of carbon dioxide, and 0.0130 lb of argon and other rare gases, at 70 F and 29.921 in. pressure, occupies 13.34 cu ft of space.

On rainy days (100 per cent relative humidity) this is thoroughly intermixed with 110.2 grains of water vapor (although this is lighter than air), and this mixture occupies 13.68 cu ft under standard conditions of temperature and pressure mentioned above and weighs 7110.2 grains.

One pound of such "saturated" air-and-moisture mixture as considered in the second paragraph of the query consists of (7000 ÷ 7110.2) x 110.2 = 0.9845 x 110.2 = 108.5 grains of moisture and 6891.5 grains of air.

SIEGFRIED RUPPRIGHT

Los Angeles 22, Calif.

Answer No. 283

Why Is Water Level Hard to Control?

IN THE December, 1944, issue, G. B. asked why the water level in his new 300-hp, 4-drum, bent-tube boiler was harder to control than the levels in his older cross-drum boiler.

There has been widespread interest in this question since that time and much correspondence with readers. A good deal of this has been published and some further comments are given below. We cannot ordinarily allot so much space to any one question but in this case it has seemed to us that the discussion has brought out much information on boiler circulation not otherwise obtainable. With the publication of these two letters, however, we must bring the discussion to an end.

Heidecker Doesn't Agree with Kuhner

MOST OF THE answers to Question 283 were of a non-technical nature. Many of us felt that the trouble was caused by the swell and shrinkage of the boiler water when the boiler was operating at ratings other than that for which it was designed.

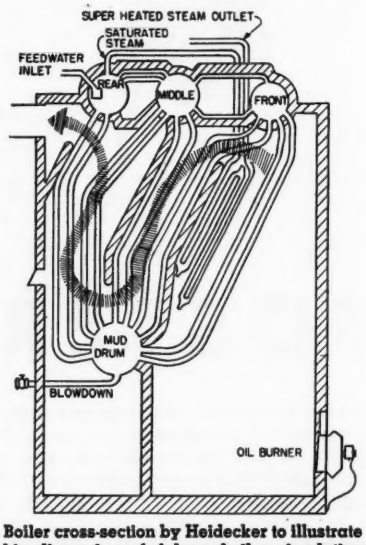
In the August, 1945, POWER PLANT ENGINEERING, Max H. Kuhner, chief mechanical engineer of the Riley Stoker Corp., in his very excellent comments (Questions and Answers, page 105), has gone into a technical discussion of water levels of the 4-drum boiler. Mr. Kuhner placed water glasses on the tube bank of the rear drum so that he could observe the water level in the tubes at different steaming rates, but he did not give us any data, merely stating that under actual conditions of 175 per cent ratings, the level of the water was over 50 in. below the rear drum. He admits that the water level in the rear drum never did go down the tubes very far at normal ratings; there was *never* actually a time when the water was as low as the 9.2 ft shown in his diagram.

If Mr. Kuhner's 4-drum bent tube boiler generates steam in the manner he describes, he isn't getting the maximum efficiency from his heat transfer surfaces.

Herewith is a diagram of a 4-drum installation showing the setting, baffles, with oil burning furnace, and the path of the flue gases over the tubes. The design of this boiler produces ideal circulation of the boiler water and combustion gases; that is, the coldest gases come in contact with the tubes containing the coldest water and the hottest gases come in contact with tubes containing the hottest water and vapor. The gases of combustion pass transversely over the front generating tubes and the super-heater, then enter the space between the front baffle and the front drum, pass downward between the baffles giving up heat to the rear tubes of the front drum and to the front tubes of the rear drum. A moderate amount of steam is generated in this pass. The gases then pass beneath the second baffle and pass over the rear tubes of the middle drum and the tubes of the rear drum: No steam being generated in this pass.

The feedwater enters the rear drum and is delivered into a trough by which the water is distributed along the whole length of the drum. The water is gradually heated as it passes downward to the mud drum, where the greater part of the material precipitated remains until blown off. From the mud drum the water passes up through all the tubes ahead of the 2nd baffle to the middle and front drums, where the steam separates from the solid water and passes through the upper connecting tubes to the rear drum. The steam issuing from the generating tubes is washed as it passes through the water in the drums. The upper network of connecting tubes acts as a dryer, very little water entering the superheater.

We agree with Mr. Kuhner that the level of the water in the front drum is not like a millpond. Not being artists, we didn't know what to do about the levels in the drums. We felt that if the front drum did fill up with a steam and water mix-



Boiler cross-section by Heidecker to illustrate his discussion of 4-drum boiler circulation

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ture, the increased pressure would force the water through the lower connecting tubes into the middle drum. There would be a vapor pressure differential over the liquid in the drums (manometer action) and this pressure differential would have a tendency to maintain a level in both drums. We finally ended up by convincing ourselves that waterlevels in diagrams should indicate the quantity of water (solid), rather than its position in the drum. We did not wish to mislead anyone and place the blame for this oversight upon our lack of artistic ability.

Getting back to the diagram, the water not evaporated passes from the front drum to the center drum through the lower connecting tubes; these tubes are baffled to prevent steam being formed in them, thus, at normal ratings, maintaining about the same amount of solid water in the front and the middle drums. The water in the middle drum passes downward to the mud drum through the rear tubes behind the second baffle when it again rises in the generating tubes. This solid water return behind the baffle maintains the water level about the same in the middle and rear drums at normal ratings. It also sweeps impurities out of the upper drums and carries them back down to the mud drum.

The principles of design and operation described in this letter are in accordance with ideas presented by William H. Severns, Professor of Mechanical Engineering, University of Illinois and Howard E. Degler, Professor of Mechanical Engineering, University of Texas, in their textbook "Steam, Gas, and Air Power."

We do not agree with Mr. Kuhner that our sketches would have been more correct if Figs. 2 and 3 on page 122 in the March issue had shown the front drums entirely filled with a steam-water mixture and the rear drum entirely empty of water. That condition is the result of forcing.

Chicago, Ill. WALTER HEIDECKER

Kuhner's Reply to Heidecker's Comments

This is in reference to Mr. Heidecker's letter on the matter of Question 283 and my comments appearing in the August, 1945, issue.

In contributing anything to the technical press it is my aim to be of assistance to the men in charge of operation and maintenance of steam generating equipment. I know that their job will be made easier if they have a clear understanding of what is going on inside a boiler under certain conditions of operation. In studying Mr. Heidecker's comments, I cannot help but obtain the impression that it is assumed I attempted to criticise a certain boiler design. I wish to state very emphatically that it never entered my mind to set myself up as a judge over other people's work. If I am critical, it is only in reference to my own work.

Mr. Heidecker's comments in no way disprove the statements I have made in the Q & A Section of your publication. In fact, if the unsupported claims are neglected, I would consider Mr. Heidecker's statements further proof of my contention that the front drum is entirely filled with a steam-water mixture and that the rear drum is entirely clear of water when the 4-drum boiler of the type illustrated is operating at higher ratings. Mr. Heidecker said as much in the last sentence of his letter.

While most laws originated by man are made to be broken, it is still not possible to break the laws of nature. If a fluid of higher density is to balance a fluid of lower density the heavier fluid must simply be of less volume than the lighter fluid. Certainly the water contained in the rear tube bank of the boiler illustrated is heavier than the steam-water mixture in front and intermediate tube banks and because the two columns must balance each other they cannot be of equal height. Mr. Heidecker rightfully claims that the feedwater enters the rear drum of the boiler and accumulates in the rear tube bank where it is gradually heated, but this is solid water and, according to Mr. Heidecker, no steam is formed in the rear tube bank.

It is not difficult for any boiler operator to prove to his own satisfaction that the level of the solid water in the rear bank of tubes is quite a considerable distance below the rear drum while the boiler is operating at full load. All he need to do is connect a vertical pipe to the upper and lower drums and to attach water gages to this pipe over its entire length. He probably will not find the water level at exactly 9.2 ft above the center of the lower drum in a boiler 20 ft. high when it is running at 175 per cent rating, but he will find a level several feet below the bottom of the rear drum.

The diagram on page 106 of the August, 1945, issue of POWER PLANT ENGINEERING was intended to illustrate a theoretical calculation predicated on the assumption that the water in the rear bank is truly solid water, that is, water free of any steam and that the steam-water mixture in the front bank of tubes consists of 99 per cent water and 1 per cent steam by weight. Actually, I would doubt that the water, practically standing quiet in the rear tube bank, is completely solid water.

Mr. Heidecker's picture attached to his letter clearly illustrates that the rear tube bank is also swept by combustion gas which is undoubtedly several hundred degrees higher in temperature than the saturation temperature corresponding with the boiler pressure. I would expect therefore that some steam is formed and that the fluid contained in these tubes is also a mixture of steam and water although of much greater density than that in the front tubes of the boiler.

Referring to the front drum, my illustration showed this drum entirely filled with a mixture of steam and water. That this is so can easily be checked by calorimeters installed through the top of the drum. Samples withdrawn through the calorimeter while the boiler is operating at higher loads are invariably a mixture of steam and water with more than 50 per cent water.

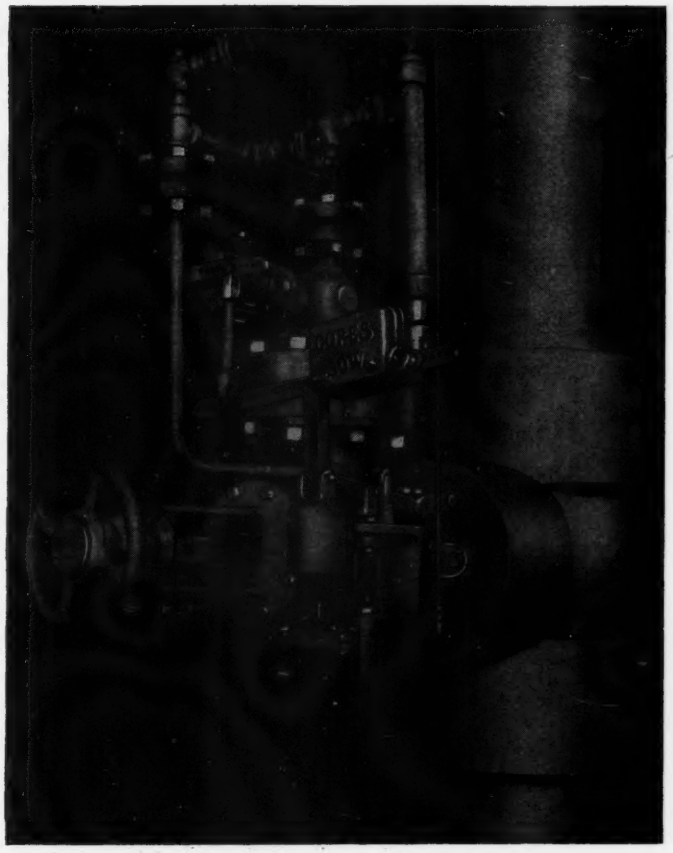
Mr. Heidecker made one statement which seems to be a very popular misconception. He is referring to the design of the boiler and states that "the coldest gases come in contact with the tubes containing the coldest water and the hottest gases come in contact with tubes containing the hottest water and vapor." A boiler designed for good natural circulation contains water and vapor of only one temperature, which is the temperature corresponding with the saturation temperature of the operating pressure. If the boiler drum pressure is 200 psig, the temperature of all water in circulation as well as the temperature of the vapor formed is 388 F. It may be that Mr. Heidecker was thinking of the water contained in tubes of the rear bank when he referred to the "coldest water," but this water is not in circulation. It is flowing through the tubes from top to bottom at the same rate at which boiler water is evaporated and is replenished by incoming feed water. A very simple calculation will prove that even water contained in the lower part of the tubes connecting the rear upper drum with the lower drum will be close to steaming temperature in spite of the fact that fresh feed water of lower temperature is fed into these tubes.

Let us assume a boiler of 5000 sq ft heating surface operating at 150 per cent rating and delivering saturated steam at 200 psig pressure, with the temperature of the entering feed water 212 F. This boiler is delivering steam at the rate of 24,600 lb per hour and, neglecting blowdown, it receives feed water at the same rate.

Now 24,600 lb of water per hour at the steaming temperature of 388 F is approximately 7.38 cu ft per minute. If the rear tube bank connecting the rear upper drum with the lower drum consists of 40 tubes 3¼ in. OD the aggregate internal area is approximately 2 sq ft and the velocity of water flowing through these tubes is therefore only about 3.7 ft per minute. The water will remain in the tubes approximately 5 minutes on its way from upper drum to lower drum. This is sufficient time for the water temperature to rise to steaming temperature if the average temperature of the combustion gas passing over the tubes is about 700 F.

MAX H. KUHNER.

Worcester, Mass.



Vertical-line installation of a relay-operated COPES Flowmatic, one of the two duplicate units controlling water feed to, and water level in, a C-E boiler operating at 675 psi and with maximum capacity of 200,000 pounds of steam per hour.

Adaptable to any installation condition or operating preference

Whatever your space limitations, installation conditions or operating preferences, the COPES Flowmatic can meet them *exactly*. The basic design of this two-element boiler feed water regulator has been projected into a highly flexible system of feed control for utility or industrial boilers.

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However your installation be made, close level control is assured by the "know how" of its designers. Write for Bulletin 429-A, which tells the COPES Flowmatic story. Your letterhead please.

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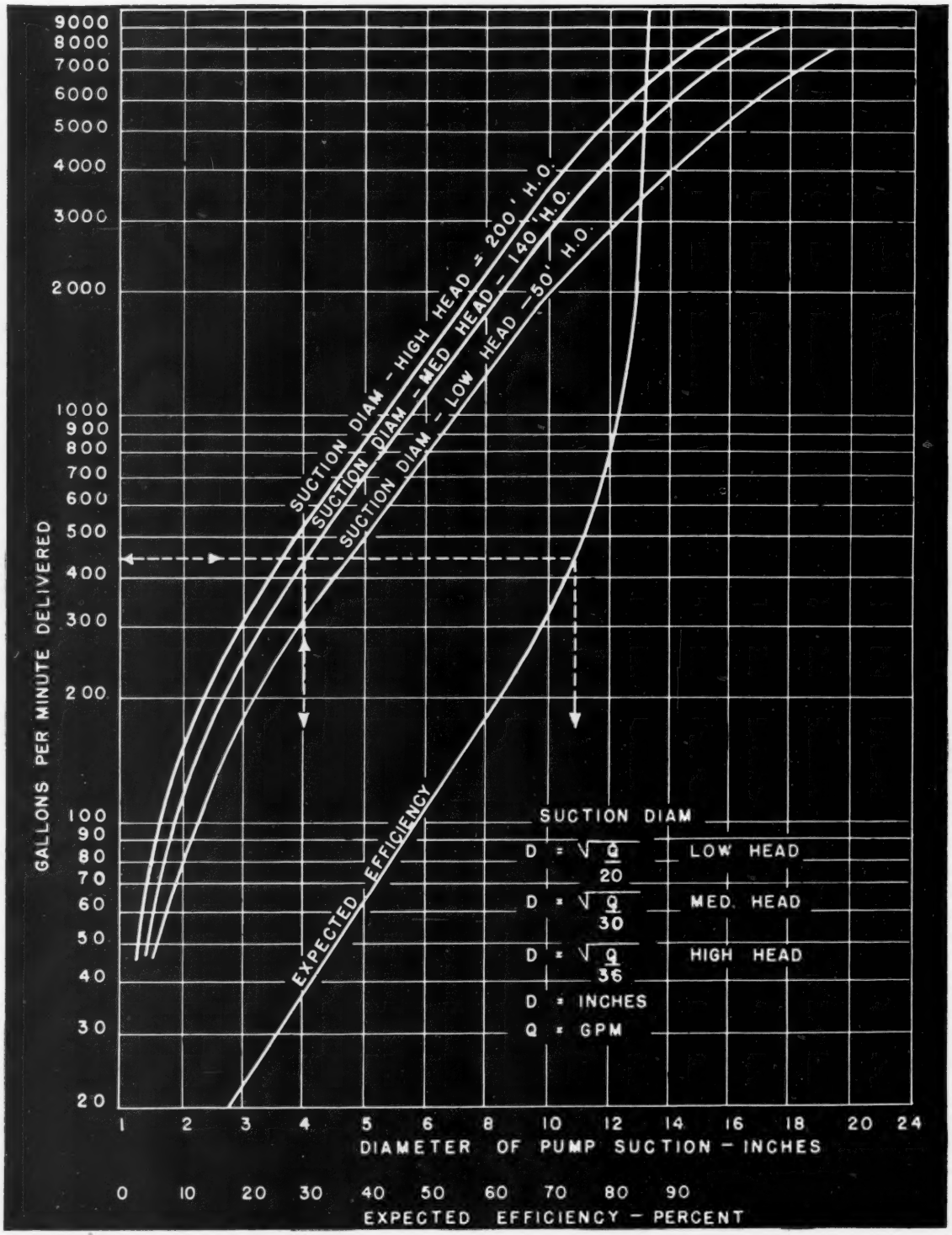
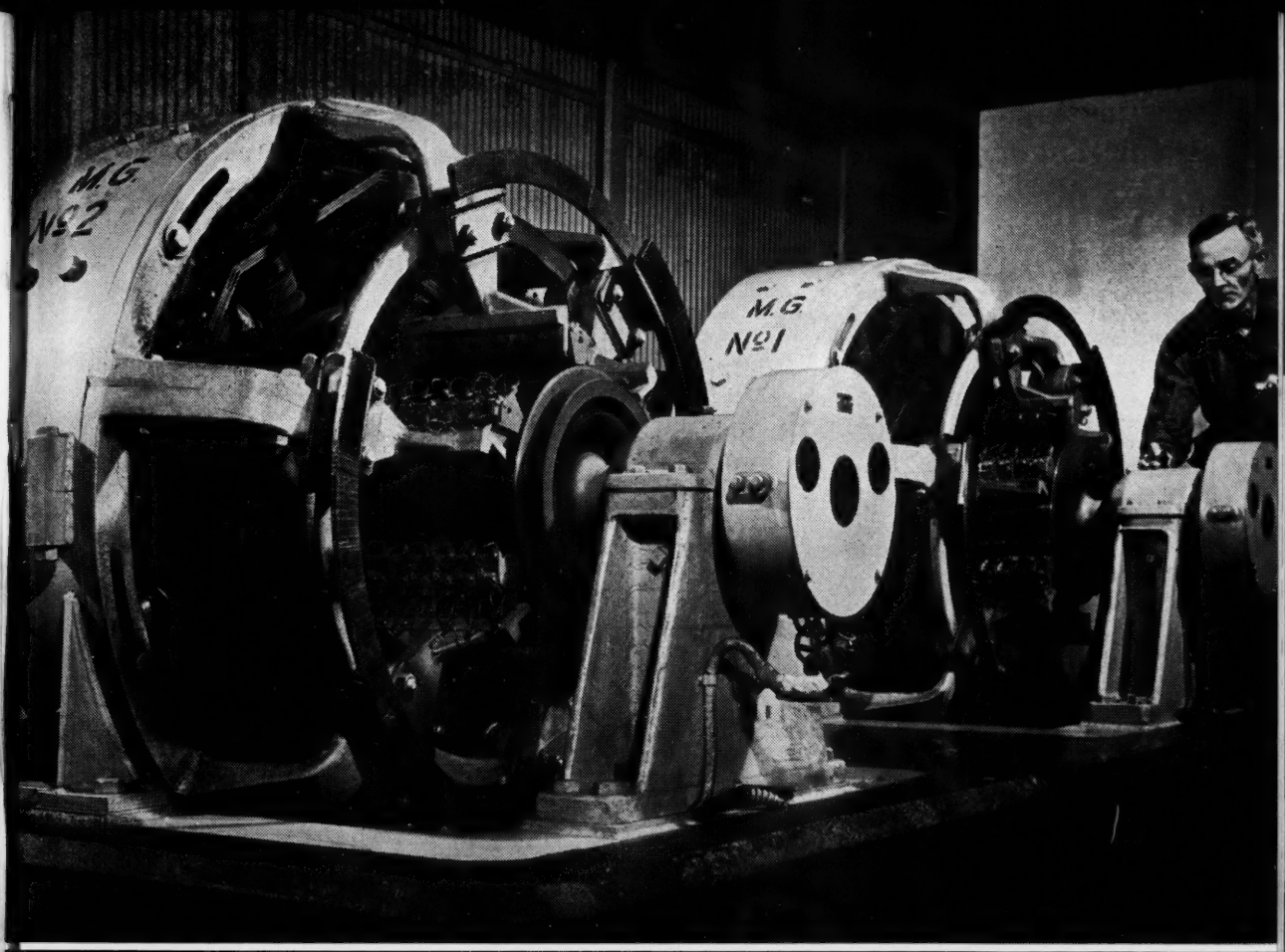
PUMP CAPACITY CHART

By BILL MADDOCK



This chart by Bill Maddock was developed to get the approximate capacities of pumps with no name plates and on which design data are not available. It gives the approximate performance of a single stage pump from a single reading of the head at shutoff.

The example shown by the dotted lines is for a 4-in. pump which showed a head of 140 ft when tested. This chart is a revision of a chart published by Mr. Maddock on page 95 of the October, 1942, issue of POWER PLANT ENGINEERING



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INDUSTRIAL PRODUCTS

The Development of Atomic Energy

(Continued from page 84)

police detachment were the last men to inspect the tower with its cosmic bomb.

At three o'clock in the morning the party moved forward to the control station. General Groves and Dr. Oppenheimer consulted with the weathermen. The decision was made to go ahead with the test despite the lack of assurance of favorable weather. The time was set for 5:30 a. m.

General Groves rejoined Dr. Conant and Dr. Bush and just before the test time they joined at the base camp. Here all present were ordered to lie on the ground, face downward, heads away from the blast direction.

Tension reached a tremendous pitch in the control rooms as the deadline approached. The several observation points in the area were tied into the control room by radio and with 20 minutes to go Dr. S. K. Allison of Chicago University, took over the radio net and made periodic time announcements.

The time signals, "minus 20 minutes, minus 15 minutes" and on and on increased the tension to the breaking point as the group in the control room which included Dr. Oppenheimer and General Farrell held their breaths, all praying with the intensity of the moment which will live forever with each man who was there. At minus 45 seconds the robot mechanism took over and from that point on, the whole great complicated mass of intricate mechanism was in operation without human control. Stationed at a reserve switch, however, was a soldier scientist ready to attempt to stop the explosion should the order be issued. The order never came.

At the appointed time there was a blinding flash lighting up the whole area brighter than the brightest daylight. A mountain range three miles from the observation point stood out in bold relief. Then came a tremendous sustained roar and a heavy pressure wave which knocked down two men outside the control center. Immediately thereafter a huge multicolored surging cloud boiled to an altitude of over 40,000 ft; clouds in its path disappeared. Soon the shifting sub-stratosphere winds dispersed the now gray mass.

The test was over—the project a success.

The steel tower had been entirely vaporized. Where the tower had stood there was a huge sloping crater. Dazed, but relieved at the success of their test, the scientists promptly marshalled their forces to estimate the strength of America's new weapon. To examine the nature of the crater, specially equipped tanks were wheeled into the area, one of which carried Dr. Enrico Fermi, noted nuclear scientist. Answer to their findings rests in the destruction effected in Japan at Hiroshima and a few days later at Nagasaki, in the first military use of the atomic bomb.

Father Divine on the Atom

According to an announcement in a Philadelphia newspaper, Father Divine, Negro evangelist, admits full responsibility for atomic energy but said he had it in harness. "I'm the author and the finisher of the atomic energy," Father Divine proclaimed in a sermon quoted in his newspaper, "The New Day," "I have harnessed it!" he said. 'I say, I have harnessed it! I am bringing all of the atomic energy into subjection, and by it I am bringing out many inventions! That is what I am doing on earth . . . today!"

Compressor Cylinder Wear

CYLINDER WEAR of approximately one-thousandth of an inch per 10,000 horsepower-hours, about one-tenth the normal wear rate, has been reported on various compressor installations by The Cooper-Bessemer Corp.

Signifying the steady progress in the design and construction of the V-type compressor units, inspection reports from the company's files reveal one case where cylinder wear for the compressor installation at the Continental Oil Co., Benevides, Texas, had 0.003 in. cylinder wear after 23,000 hr of operation, or about 0.001 in. per 9500 operating hours. This is said to be almost ten times better than the normal wear rate.

An installation at the Federal Glass Co. of Columbus, Ohio, showed only 0.001 in. of wear on the power cylinders after 3 yr of operation.

Some of the principal developments which have contributed to this phenomenally low cylinder wear, according to engineering authorities of the manufacturer include the extensive use of Meehanite metal, an exceptionally close-grained iron alloy which gives extra strength and wear-resistance; extensive research which has brought about a considerable reduction in piston ring thickness, the narrower rings providing ample seal and causing less wear; and a piston design which permits effective, uniform heat dissipation.

There have also been numerous refinements in the fabrication and finishing of the cylinder components, including the use of a vertical honing machine which is designed to attain utmost precision in cylinder finishing.

THE TWENTIETH CENTURY FUND survey of collective bargaining reveals the fact that more than one quarter of the wage and salary workers in the United States were covered by collective agreements before the war.

Industry to the Colleges —Correction Note

IN THE *above article, October, 1945, issue, page 65, the photograph captioned K. B. McEachron, Jr., and the corresponding co-author's biography are those of his father, which were sent to us by mistake along with those of the other two co-authors. The correct photograph and biography of K. B. McEachron, Jr., are given below; please substitute them in your copy of the October issue.*

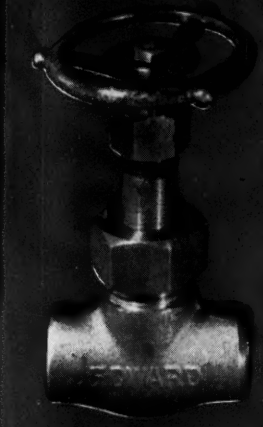
This unfortunate confusion of identities occurred because, at the time, we did not know that there were two McEachrons, both members of the GE organization. Hence we had no reason to question the data as received; nor was the error detected when galley proof was submitted to GE for approval. We regret this error exceedingly.

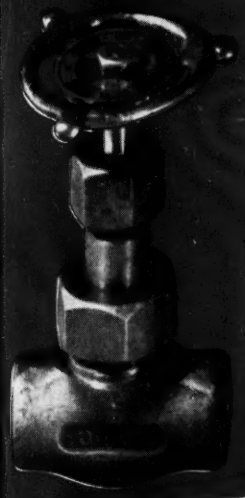
K. B. McEACHRON, JR.

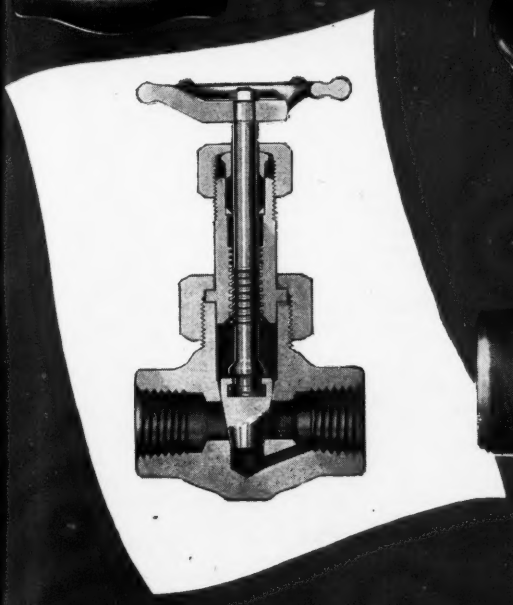
K. B. McEachron, Jr., was born in 1915 at Ada, Ohio, where his father was professor of electrical engineering at Ohio Northern University. In 1922 his father joined GE in the Lightning Arrestor Department at Pittsfield, Mass.; young McEachron grew up there, attending grade school and the local high school. In 1937 he was graduated at Purdue University with the degree of BS in electrical engineering.

He joined GE at Pittsfield in that same year, on transformer test. He was selected for the A class of the Advanced Engineering Program at Schenectady in the fall of 1937, was graduated from the three years of the program in 1940 and supervised the A class in 1940-41. In 1942 he was placed in charge of the Advanced Engineering program at Schenectady, the position he still holds.

He is a member of Eta Kappa Nu, Tau Beta Pi, Sigma Xi, AIEE and SPEE. He was co-author with A. R. Stevenson, Jr., of "Education of an Engineer", SPEE Journal of Engineering Education, December 1944; "Industry's Responsibility for Post-Collegiate Education," Mechanical Engineering, May 1944.







Straight-through

FLOW

for small pipe lines

For small lines where straight-through flow is required, here is an ideal valve. Especially suitable for sampling, viscous fluid and instrument line service.

Body and bonnet are forged steel and the disk is a truncated cone swivel plug, giving full contact against a borized conical seating surface. A diagonal pressure relieving hole is drilled below the disk to facilitate seating or unseating. It may also be used to open a passageway for cleaning out the valve.

Three styles are available

Fig. 150—Carbon steel body and bonnet, stainless steel trim.

Fig. 2150—All stainless steel.

Fig. 4150—All "18-8" steel.

Built in ⅛ in. to 1 in. sizes inclusive.

Write for Catalog No. 103.

Edward Valves, Inc.

Subsidiary of Rockwell Manufacturing Co.

EAST CHICAGO, INDIANA

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. Write to POWER PLANT ENGINEERING 53 W. Jackson Blvd., Chicago 4, Ill.

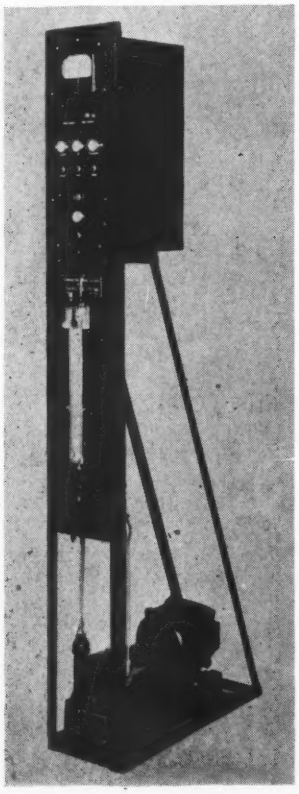
Combustible Gas Alarm

THE NEW Davis Combustible Gas Alarm System, remote head type, has been introduced by Davis Emergency Equipment Co., Inc., 45 Halleck St., Newark 4, N. J., designed to detect the presence of combustible vapor and/or gas, give an audible signal before mixture with air becomes dangerous and control appliances, such as shutting down machines, starting ventilating, etc.

The analyzer head is housed in an explosion-proof condulet and is located in the area being sampled. Thereby the analysis is made under the actual temperature conditions at the point where the gas or vapor-air mixtures exist. This obviates the necessity of drawing the sample through a long tube, possibly through lower temperatures, which may cause condensation of all or part of the vapor, thus registering an inaccurate measure of explosive conditions.

The control cabinet may be located at any distance in a gas-free area. The signal of any change in the gas and/or vapor concentration reaches the control cabinet through an electric cable and therefore the response is instantaneous.

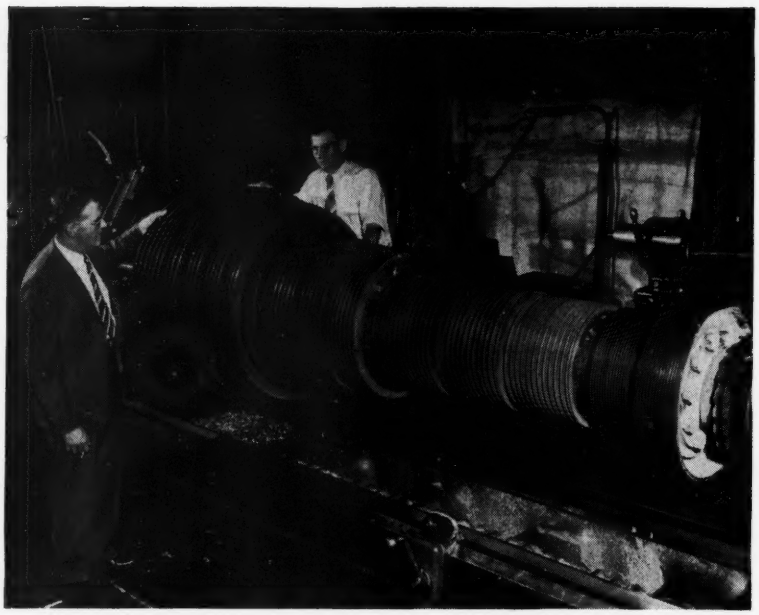
In principle, this system utilizes the effect of combustion of flammable gas-air or vapor-air mixtures on the surface of a heated element. This combustion increases the temperature and consequently the electrical resistance of the filament. This increase in resistance diverts part of the current, flowing in a special circuit, through a meter which is calibrated in terms of the lower explosive limit of the gas or vapor being detected. The heated filament is located in the analyzer head.



When the gas or vapor-air mixture reaches a preselected percentage of the lower explosive limit, a series of relays close to sound an audible signal, and to control appliances. Machines can be shut down, ventilation may be started or increased, fire prevention, such as CO_2, foam or other extinguishing systems can be actuated. In fact, any function may be performed which is made possible by opening or closing an electrical circuit.

Any number of analyzer heads can be employed. Each being a complete unit, independent of the others, each may be calibrated for individual gases. Yet, control cabinets can be grouped together, each connected to its analyzer head, and all served by the same pump. A separate panel under each control box, shows flow of sample on mercury column and mounts a purge and sample valve.

The filament blow-out signal gives operator a visual and audible indication if any analyzer head is temporarily inoperative. Simple filament replacement is possible. This new system can analyze combustible gases in any range from 0 per cent to 100 per cent. It visibly and audibly indicates the approach of such gases to dangerous limits, giving warning before a fire or an explosion could take place.

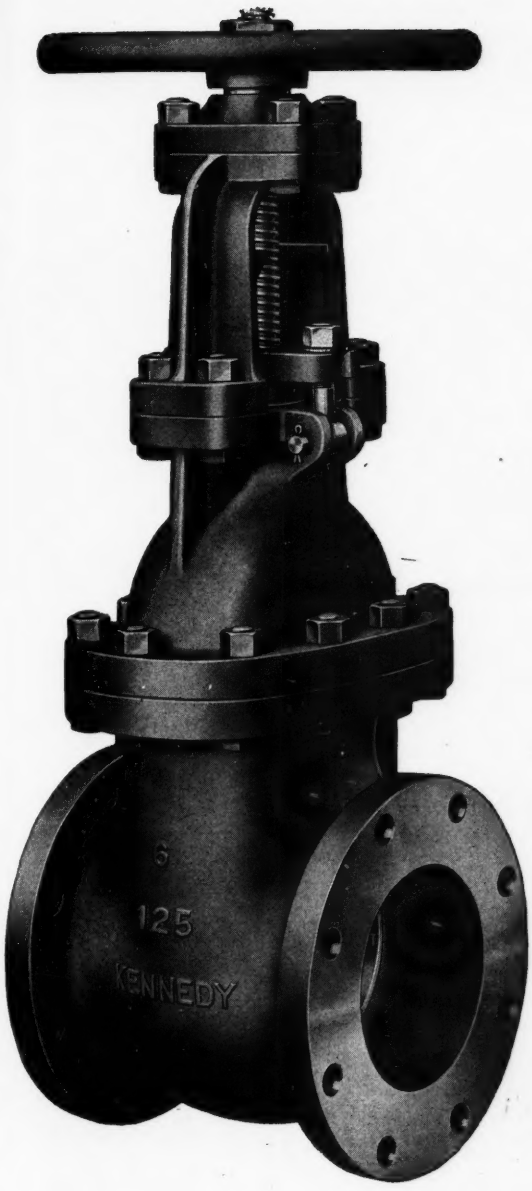


THIS STEAM TURBINE spindle is back to Allis-Chalmers shops for the first major maintenance it has ever required, after 36 years of service. The spindle is in the care of foreman Frank Lein, who recalled having machined it himself in 1909 on a lathe that, by coincidence, Allis-Chalmers in 1909 it was put into service by the Memphis Consolidated Gas & Electric Co. Seventeen years later, it was purchased by the Bradley Lumber Co. of Arkansas, where it ran the years around until recently. With Lein is Preston Reaves, assistant to the electrical was scrapped only a few months ago. When the steam turbine left engineer for the Bradley Co.

Corrosion-Resistant Steel Pipe

BY A NEW process the inside of steel pipe can be electroplated with nickel or other metals. The process developed by the Bart Manufacturing Co., 227 Main Street, Belleville, N. J., is relatively inexpensive and is known as the "Bart Lectro-Clad Process." It develops a smooth, ductile, pore-free nickel deposit fully adherent to the base metal, and it can be applied to pipe or tubing up to 18-in. overall diameter, in random lengths approximately 20 ft. Use of the process endows steel pipe with the corrosion-resistance of nickel, while retaining the low cost, strength, and fabricating characteristics of the steel.

Fittings and pipe line accessories are available for complete piping systems. Welding and fabricating techniques reported to have been fully developed. The internally plated pipe can be welded, reduced and bent, hot or cold, without destroying any portion of the internal lining. In reducing tubing by the cold reduction method, it is now possible to predetermine the actual thickness of the plating throughout the entire reduction, because the applied metal and the base metal reduce in equal ratio.



- **RELIABILITY**
- **STRENGTH**
- **ECONOMY**
- **SAFETY**

. . . characteristics of every KENNEDY *valve*

Kennedy Valves are reliable because of their simple, sturdy and effective operating mechanisms. Many of these mechanisms were originated by Kennedy, and have proven their effectiveness in thousands of installations.

These valves are economical because of their durability which has been demonstrated by decades of service in many installations without maintenance expense.

Their generous proportions of all parts, together with high-quality, high-tensile-strength metal, assure ample strength and complete safety. You are always safe with Kennedy "Extra Value" Valves.

THE KENNEDY VALVE MFG. CO.
ELMIRA • NEW YORK

KENNEDY *valves . . . pipe fittings . . . fire hydrants*

Pneumatic Relay

A PILOT-OPERATED pneumatic relay of great versatility, used to add or subtract loading pressures received from external sources and designated as Type F Totalizer is the product of Hagan Corp., Pittsburgh, Pa.

The device is also used as a regulator. In a control system, the function it performs depends upon the manner in which the loading pressures are applied to the several diaphragms of the totalizer. It requires a source of compressed air at substantially constant pressure for its operation.

From the standpoint of sensitivity, the totalizer will effect a reproducible change in outgoing loading pressure on as little as 0.1 percent change in incoming loading when the output loading pressure is at maximum.

The totalizer may be used in connection with a measuring flow element and a power unit to regulate fluid flow, temperature, pressure, level, speed, or any other physical condition that can be transformed into a loading pressure as an indication of magnitude. When used as an element in a control system, the totalizer may perform any of the following functions:

1. Add or subtract loading pressures, thereby totalizing fuels to a boiler or furnace fired with multiple fuels, or setting up the flow of auxiliary fuels.

2. Average two or more loading pressures, thereby indicating the air requirements for groups of burners or pulverizers.

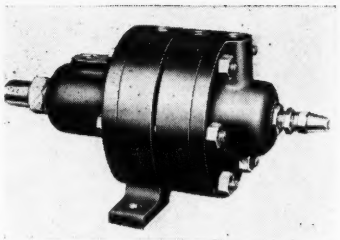
3. Act as a selector of loading. In a typical application, this action may serve to control fan speed on the basis of the air pressure requirements of the most heavily loaded of several burners.

4. Respond to loading pressures sequentially. This action might be used to set up the sequence of operation of several different burners or fans.

5. Produce anticipating or derivative action. Used in this manner, the totalizer may be applied to overcome the effect of storage in some control applications.

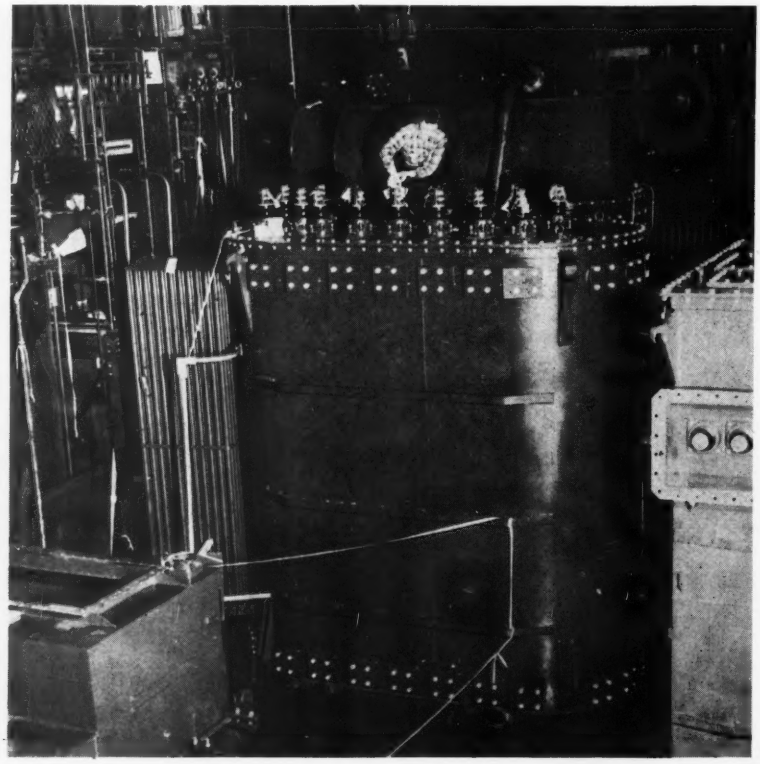
6. Operate as a safety relay. One example is its use to limit the rate of firing of a boiler or furnace to that corresponding to maximum induced draft fan capacity.

7. Act as a pneumatic stop for diaphragm-operated valves, receiving regulators, etc. In some cases it may



be desirable to limit the maximum or minimum opening of valves or dampers under automatic control without interfering with the ability to move these valves through their entire range under manual control.

8. Invert loading pressures. When used for this purpose, the totalizer will transmit a loading pressure moving in the direction opposite the change in loading received from external sources.

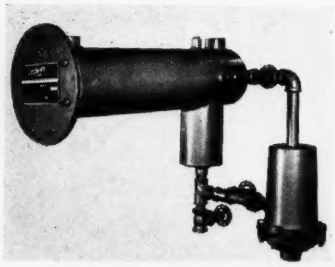


Power Transformer Under Factory Test

Perched on a mercury-arc-rectifier oil-immersed transformer rated 50 cycle, 9800 kva, 10500Y to 800Y volts, Mrs. Ruther Rogerson of General Electric's transformer test section at the Company's Pittsfield Works is preparing to make one of the series of close checks to which all G-E transformers are subjected, in accordance with the American Standards test code. Such tests regularly include exciting current and no load loss, copper loss, winding resistance, voltage ratio, impedance, and dielectric tests. Heat runs are also frequently made to check ultimate operating temperatures. The test records are kept permanently.

Water Separator for Fuels

FOR REMOVING WATER, dirt and muck from fuel oils at storage tanks, fuel trucks, Diesel engines, barges, water terminals, and many other places where Diesel oils or gasoline are handled or stored, the Flotrol Systems, Inc., 395 Gerard Avenue, New York 51, N. Y., has developed what is called E-25 Excel-So Water Separator and Filter.



This device is a little over 2 ft long and it can easily be mounted on trucks or in crowded compartments. Its capacity is 25 gpm. The evenly bedded, deep, coalescing media also traps solids, with extremely highly filtering efficiency and tremendous dirt capacity. With clean fuels, the media will last indefinitely but when handling dirty fuels, the media can be replaced quickly with an inexpensive repack whenever required.

Industrial Liquid Cooler

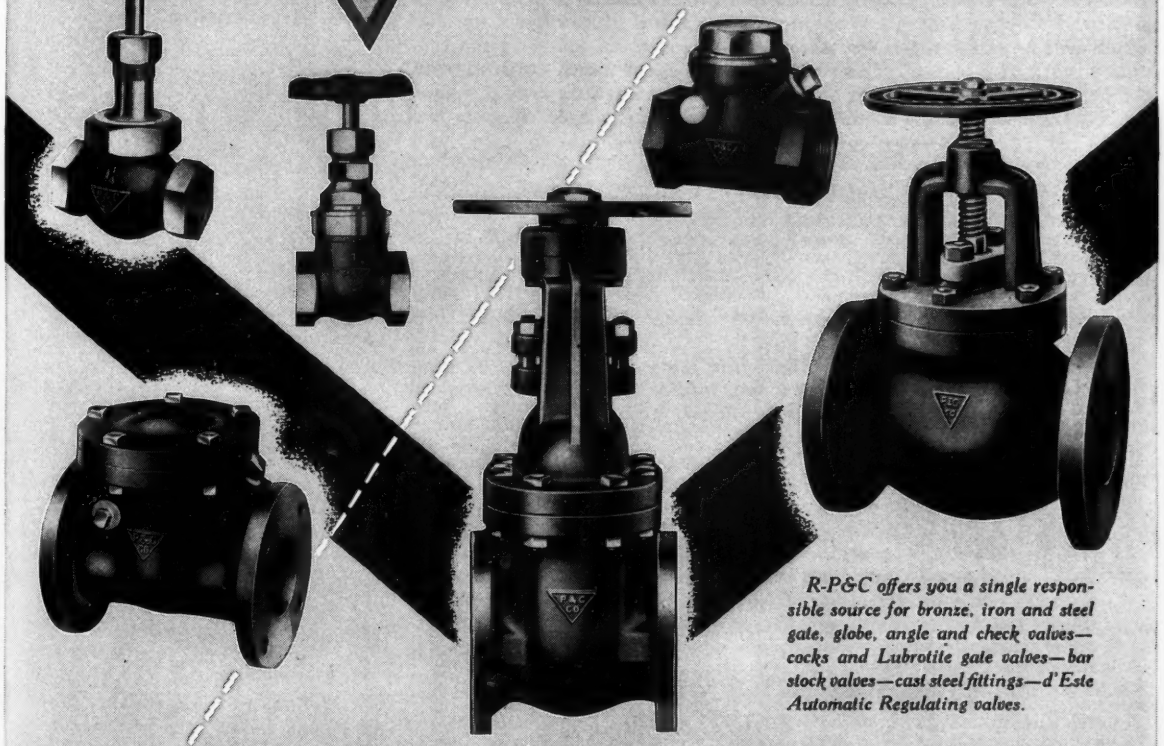
TO FURNISH REFRIGERATED cooling water or any aqueous solution for industrial uses, especially the cooling of water to the lowest possible temperature above freezing for air conditioning or water cooling jackets, the Niagara Blower Co., 6 E. 45th St., New York 17, N. Y., has developed an industrial liquid cooler.

The method used is to spray the cooling water over banks of coils in which the refrigerant is expanded. The water falls into a tank and is recirculated independently of the distributing system, thereby gaining the closest control over operations or variations from maximum cooling load.

MORE AND BETTER *Service* FROM TODAY'S VALVES

"RESOLVED:
"That the superintendent
"shall be held responsible
"for the production of goods
"as near perfect in design,
"material and workmanship
"as shall make them merchantable
"and of a character that will serve
"to establish for this company
"a high reputation."

The policy expressed by this early Pratt & Cady Board of Directors Resolution has not been shaken even by the great World War. More than ever before the valves offered by Reading-Pratt & Cady today meet the demand for longer and better service.



R-P&C offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—cocks and Lubrotile gate valves—bar stock valves—cast steel fittings—d'Este Automatic Regulating valves.

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MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
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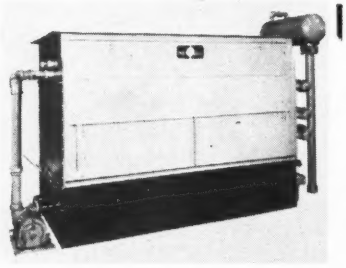
ACCO

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

ACCO TRADE MARK

Life Rafts to Serve Industry

BUILT ORIGINALLY for saving the lives of merchant seamen, these life rafts recently were acquired by the Bureau of Reclamation at Grand Coulee Dam in Washington State for supporting catwalks which will be constructed for workmen employed on spillway maintenance work at the dam. The rafts, made of sheet metal covered with protective fabric, are among the surplus war materials recently purchased by the Bureau. Each raft was designed to hold 25 persons.



By means of newly developed coil arrangement and design, capacity increases of 50 per cent to 100 per cent are gained over the company's previous equipment in comparable sizes. The result is equipment of greater compactness, capacity and rapidity of cooling as well as absolute temperature control. It is possible to produce 33 F water constantly without danger of damage from freezing—as the system is open and does not depend for safety on the proper functioning of the back pressure regulating valve. To provide temperatures below freezing, the coolers may be operated with a special liquid solution.

The range of capacities in different sizes runs from 4.7 to 137 tons refrigeration. The model rated at 137 tons is 105 in. long by 88 in. high by 60 in. wide. Water deliveries range from 11 to 220 gpm.

Electrode for Welding Cast Iron

MACHINABLE WELDS in cast iron can now be made with a new welding electrode introduced as a product of The International Nickel Company's new electrode plant at the company's Bayonne Works. It represents a development by the Inco Development and Research Division's Research Laboratory with the cooperation of the Bayonne Works.

Besides this new electrode, designated by the trade name Ni-Rod, another new electrode also has been developed. This is the "135" 80-20 nickel chromium electrode for welding the Inconel side of Inconel clad steel. Besides these, six other electrodes are now being produced at the plant for arc welding. Gas welding rod and uncoated wire for submerged melt welding are produced at the Huntington Works of the company. The six types of electrodes are designed for Monel, Inconel, nickel, "L" Nickel, "K" Monel, 70-30 cupro-nickel, and the various clad steels. Among them is another new product, "132" AC-DC rod for Inconel. The Bayonne Works also produces fluxes for gas welding and brazing of these materials.

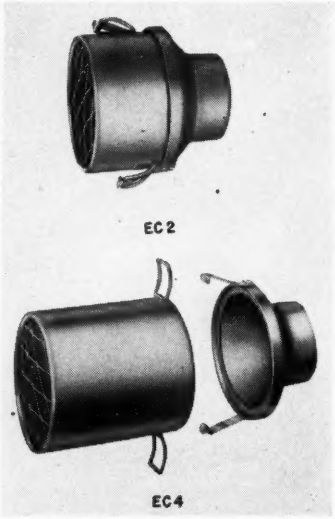
Production follows the same pattern for all types of electrodes and is carried out in automatic equipment, beginning with the mixing of the flux, following through the slug press, loading into the magazine of the flux extrusion press and passage through the new 90-ft multiple-pass conveyor oven.

Each electrode passes through the oven, back and forth, five times, starting from the top and discharging at the lowest level end. Maximum capacity of the plant is over 1000 lb of electrodes an hour.

Air Filters

ORIGINALLY DESIGNED for railroad service and thoroughly proven in this exacting field, a new type of air filter is now made available, by the Farr Co., 2615 Southwest Drive, Los Angeles, California, for quick installation on air compressors of all types, small internal combustion engines and any machinery requiring air filter equipment. Identified as the Far-Air EC filter, it will be made up in diameters of from 7 in. to 14 in. with capacities from 90 to 730 cfm.

As illustrated, the complete unit is composed of the filter element enclosed in a cylindrical steel housing, and a cast iron adapter base. The filter element is of the same herringbone crimped screen design used in Far-Air ventilating filters, permanent and easily cleaned.

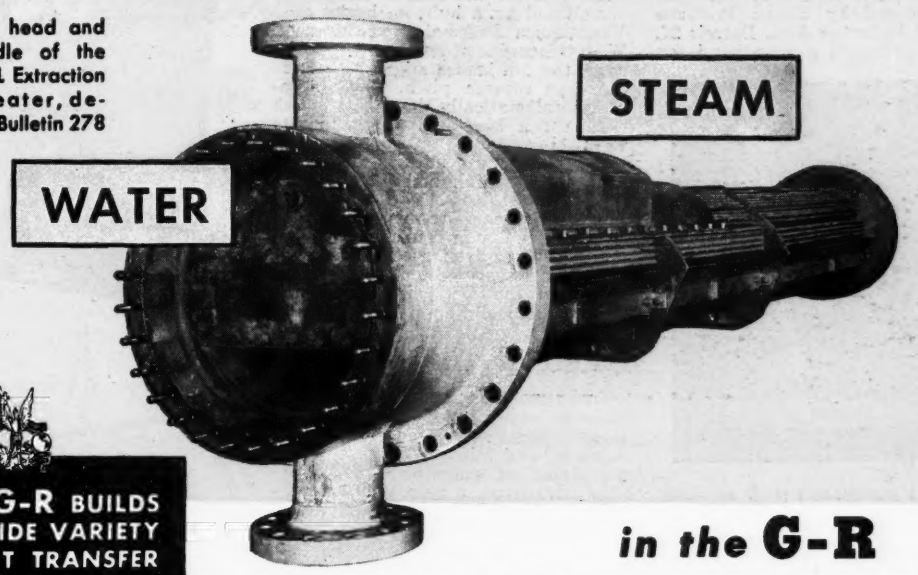


It is spirally wound into a 2 in. pack and, for average service conditions, the ECA2 filter contains two of these packs. The EC4 filter, containing four packs, is recommended for heavy-duty service. Far-Air EC filters are installed by screwing the cast-iron adapter fitting onto the intake pipe. This adapter has a standard 3 in. pipe thread and remains permanently in place. The filter unit is then locked into the adapter, bale handles on the filter unit barrel snapping into heavy-duty spring clips attached to the cast iron adapter.

EC filter units can be cleaned with high pressure hot or cold water, or by agitating in a tank of any good commercial cleaning solvent. Once cleaned, they should be dried and re-oiled before reinstalling.

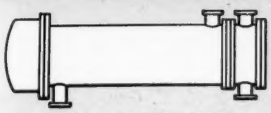
MOST EFFICIENT USE OF...

Stationary head and tube bundle of the G-R Type L Extraction Steam Heater, described in Bulletin 278



ONLY G-R BUILDS THIS WIDE VARIETY OF HEAT TRANSFER APPARATUS

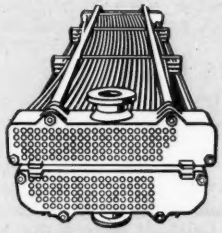
in the G-R EXTRACTION STEAM HEATER



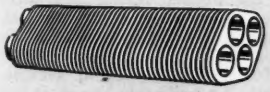
SHELL and BARE TUBE
Heaters, Coolers, Condensers, Heat Exchangers

G-FIN
Longitudinal-finned elements for greater heat conductivity

K-FIN
Helical-finned elements for vapors and gases



BENTUBE EVAPORATOR
Scale-shedding Elements



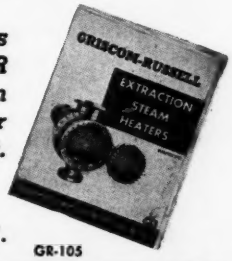
TUBEFLO SECTIONS
Non-clogging design for residuum and other dirty fluids

Seventy-eight years of specialization and pioneering in the development of heat transfer apparatus have made the G-R Extraction Steam Heater far more than merely a bundle of tubes in a shell. For example:

STEAM is properly distributed above and around the heating surface of all G-R Heaters by a steam impact baffle. This baffle also guides the steam properly throughout the entire tube bundle, and protects the tubes from erosion, vibration or chafing. In low pressure heaters, large steam distributing domes are provided, and when the heater is to operate with highly superheated steam, a patented enveloping baffle permits cross-over temperatures and protects the shell from high temperatures.

WATER is prevented from leaking between passes by patented partition pass plates which do not require staybolts. High pressure heaters have heads with visible pressure seal, and do not require the large number of heavy bolts which are necessary in other high pressure designs.

These features, together with many others which distinguish the various types of G-R Extraction Steam Heaters, are described in Bulletin 278 which every plant engineer should have. Your copy sent on request.



THE GRISCOM-RUSSELL CO.
285 Madison Ave. New York 17, N. Y.

GR-105

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

Thermo-Control Fan

FOR TEMPERATURE CONTROL of internal combustion engines, a new thermostatically-controlled fan has been developed by Evans Products Co., 15310 Fullerton Ave., Detroit 27, Mich. Its principal application is on

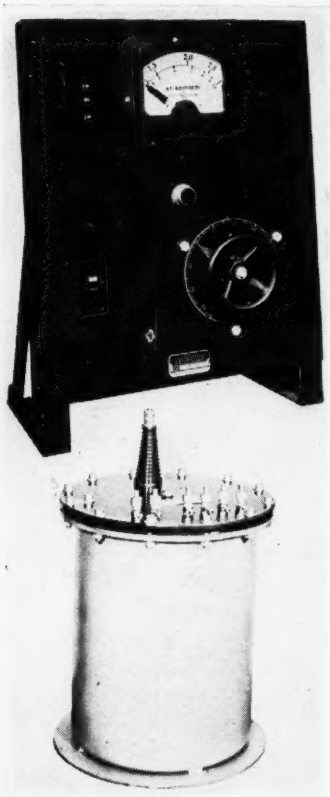
heavy duty equipment, such as buses, trucks, stationary engines, tractors, shovels and Diesel locomotives.

The new Evans Thermo-Control Fan automatically adjusts itself to produce economical operating conditions, by means of variable pitch control of the fan blades. This is accomplished by a built-in, heavy duty Vernatherm Thermal power element. With the engine at low load or on cold days, the fan blades might be at zero pitch or reverse pitch. The Vernatherm automatically changes the pitch of the fan blades, through infinite variation, to the maximum which would be required under heavy loads or extremely high ambient temperature.

With the conventional fixed-pitch fan, the maximum fan horsepower is used for any given speed. This high horsepower consumption is eliminated much of the time by the Evans Thermo-Control Fan.

Stationary A-C Test Set

DESIGNED ESPECIALLY for the fixed-location testing of medium sized motors, generators, transformers, insulators, and other equipment where a portable set would be of no particular advantage, a new 15,000-v, stationary, a-c test set has been announced by General Electric Co.,



Schenectady 5, N. Y. Operating from any single-phase, 60-cycle, 115-v supply circuit, it provides variable test voltages up to 15,000-v a-c, with a capacity of 2 kva.

The set consists of an oil-insulated step-up transformer and a separate vertical-type control panel, permitting a variety of installation arrangements to meet individual requirements. With over-all dimensions of only 23 by 18 by 25 in., it is suitable for installation where space is very limited. Included in the set is a variable-voltage, auto-transformer for smooth stepless control of output voltage, a highly accurate double-scale switchboard-type voltmeter energized from the voltmeter coil of the transformer, a voltmeter-scale selector switch, an air circuit breaker with instantaneous overload trip, and a red signal lamp.

First Photos of Underwater Welding

The practicability of welding and cutting under water has been proven successful by a number of recent applications, such as salvage work on damaged war vessels. Only the diver or a companion has been able to see the actual operation of this modern technical development of the arc welding process. Now, for the first time, so far as known, underwater welding has been successfully pictured.

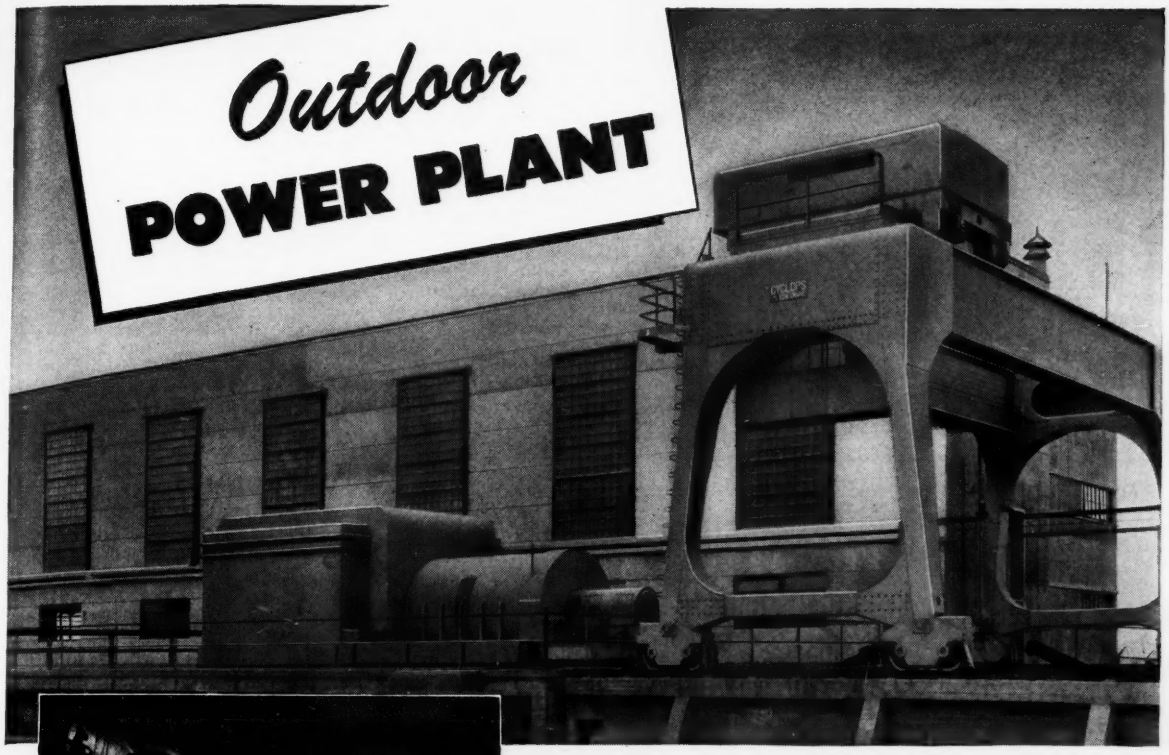
Shown here is R. L. E. Cook, welding engineer for Armco International Corp. and representing The Lincoln Electric Co., Cleveland, Ohio, arc welding under 15 ft of water. The welding is being done with a mild steel electrode having a special coating that is impervious to water.

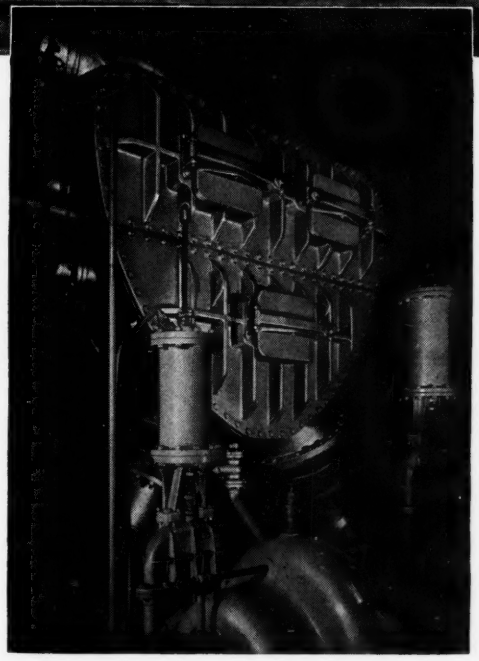
The photo was taken through a porthole in the specially designed tank used for training welders in underwater welding and cutting operations in the mechanical division of The Panama Canal Zone.

Pressure Reducing Regulator

THE NEW SMALL and compact Grove Mity-Mite regulator weighing less than 2 lb and measuring roughly 2¾ in. by 3¼ in. is a product of Grove Regulator Co., 6491 65th St., Oakland 8, Calif., is suitable for handling initial pressures up to 3500 psi with adjustable control range from 5 psi to 1500 psi. Special models can be supplied for higher initial pressures ranging up to a maximum of 5000 psi.

Although primarily designed for air and gases, this diminutive unit can also be furnished for liquid service. Its strength is attributable to stainless steel ports and the homogenous structure of Duraluminum from which it is made. Unique valve and seat construction was especially engineered





The upper photo shows the Glendale turbine generator and the traveling gantry crane which serves all outdoor equipment. The lower photo shows the water-box end of the I-R surface condenser. The two circulating water pumps have gate valves which are operated by compressed air.

WITH INGERSOLL-RAND CONDENSING UNIT

For more than four years, the City of Glendale, Calif., has been operating a generating unit which is installed in the open—an arrangement which has proved practical and economical from every standpoint.

Aside from the inexpensive sheet-metal housing over the steam turbine, the equipment in this 20,000-KW outdoor installation is identical with that which would be used for an installation under roof.

The complete condensing plant, installed in a basement underneath the turbine generator, was supplied by Ingersoll-Rand. It consists of a two-pass horizontally-split surface condenser, a twin two-stage steam-jet air ejector, and two motor-driven single-stage centrifugal pumps which handle circulating water for the condenser.

Complete condensing plants have become a specialty with Ingersoll-Rand. Hundreds of power plants of all sizes are today enjoying the benefits of the unified engineering of the steam condensers, ejectors and pumps which comprise the modern I-R condenser plant.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

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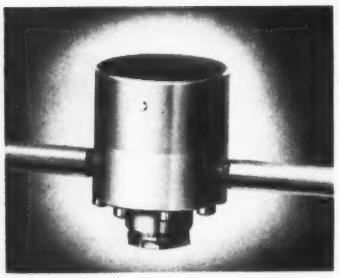
COMPRESSORS CONDENSERS • TURBO BLOWERS • CENTRIFUGAL PUMPS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES



for positive dead-end shut-off, available for ⅛ in. and ¼ in. pipe size, this tiny unit was originally developed and thoroughly proved in wartime service, where it was extensively employed in controlling the actuating medium on rockets and pack type flame throwers.

Pipe Sealing Compound

DEVELOPMENT and introduction of a new sealing compound has been announced by Bowser, Inc., Fort Wayne 2, Ind. This new compound, known as Black Magic, is a pipe sealing material and gasket cement suited for use in handling such liquids as gasoline, oils, water, steam and a large variety of others except those containing alcohol or made with an alcohol base.

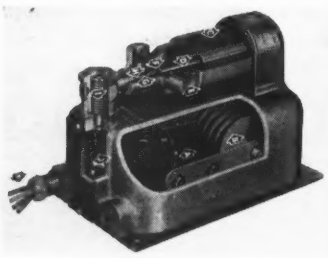
Black Magic is reported to form a permanent seal in pipe joints or gaskets, yet retain enough flexibility to permit expansion and contraction of metals without cracking. Inasmuch as this compound does not become brittle with age, it is particularly applicable to underground piping where strains eventually cause leakage when brittle compounds are used.

This compound clings like glue to metal, and being completely insoluble in gasoline it is successfully used in oil pump and gas work, oil burner installations, bulk storage and refinery piping or wherever petroleum oils are used or stored. It is sold in tubes or cans ready for use.

For Hydraulic Brakes

WAGNER ELECTRIC CORP., 6400 Plymouth Ave., St. Louis 14, Mo., has developed a new brake control unit for the Wagner Type HM cranebridge brake which provides automatic cushioned emergency stops when power fails or crane runs beyond safe limits on the runway. This brake control unit permits free use of the foot controlled hydraulic brake for service stops while at the same time it holds the parking-brake setting-spring compressed and ready to apply the brake in an emergency.

The cushioned-stop valve of the control unit applies the brake at a predetermined rate to bring the bridge and its load to a quick, smooth, stop without undue swinging of the suspended load. With this control unit installed in the system the operator has a hydraulic brake for service stops, a spring-set brake for parking plus an automatically applied cushioned-stop brake for emergencies.

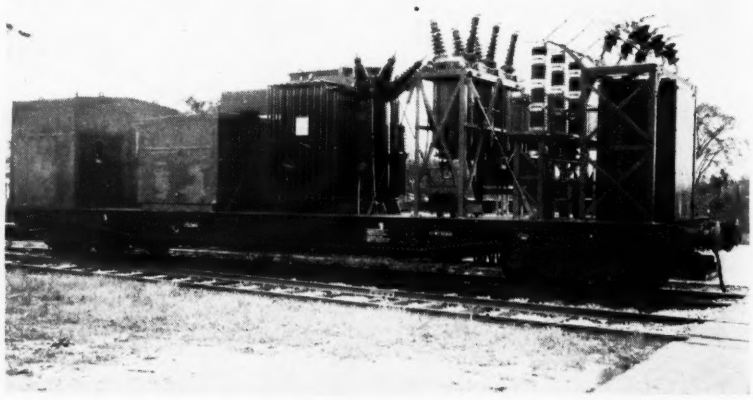


For explanation of how the brake control unit works refer to the illustration which is a unit for use with alternating current and has a transformer (A) and a selenium rectifier cell (B) that converts the line current to 12-v d-c for operating the cushioned-stop valve. In the direct-current unit, resistors are used in place of the transformer and rectifier.

While the crane is in operation electromagnet (C) is energized, holding plunger (D) against escape port in sealing cup (F). In this position whenever the operator uses the brake for service stops fluid enters port (E) and goes directly to the brake actuating-cylinder from outlet port (hidden in this photograph) opposite of port (E). When line circuit (K) is opened, as by a limit switch or power failure, magnet (C) is de-energized, releasing plunger (D) and permitting the escape of fluid from hydraulic releasing cylinder mounted on the brake. This fluid must pass metering disc (G) which meters the escape of fluid so as to allow the brake to set by spring action at a predetermined rate.

To release the parking brake the operator makes a full application of the foot pedal. Fluid entering port (E) passes readily through sealing cup (F), since magnet is now de-energized, and out the lower port to the hydraulic-releasing cylinder to compress the brake setting spring. Fluid is also forced through tube (H) and acts on plunger (I) to close switch (J). With the closing of switch (J), magnet (C) is energized thereby trapping hydraulic fluid in the releasing cylinder and holding the brake setting spring compressed.

The control unit is located near the brake. A pushbutton station with signal light is located in the crane cab. To apply the brake for parking the operator merely presses the pushbutton. The signal light goes out indicating that the brake is on. The foot-controlled hydraulic brake for service stops, the spring-set brake for parking, and the automatically applied emergency cushion-stop brake are all combined in one brake. The triple-duty feature and the cushioned emergency stops are made possible by the new brake-control unit.



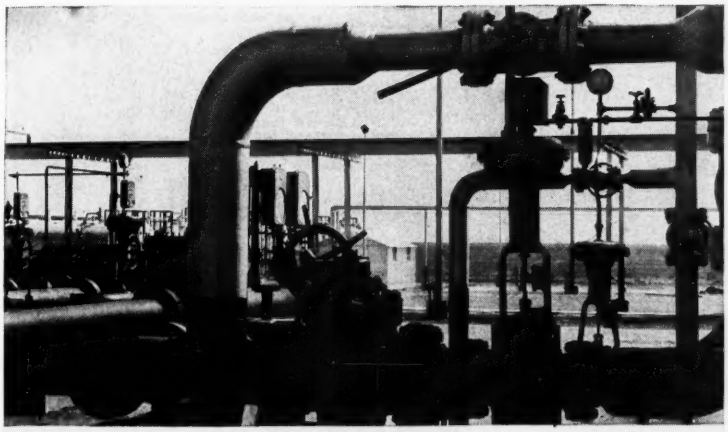
Railroad Mounted Unit Stations

GENERAL ELECTRIC'S Pittsfield Works has recently completed the first of 15 railroad-mounted unit substations for the Union of Soviet Socialist Republics. These will be used in the rehabilitation of towns and cities that were devastated as a result of the war. They have been designed and planned to serve the electrical needs in war torn areas and maintain service until permanent substations can be built for these areas. They are completely mobile.

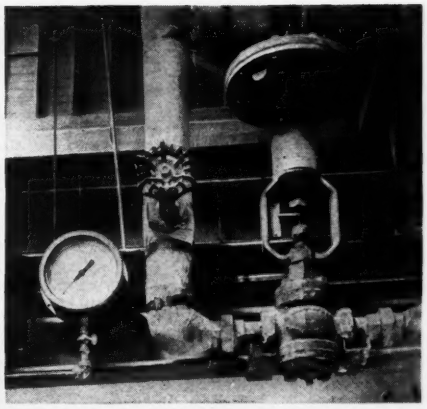
When permanently mounted on flat-cars, the entire unit substation weighs 111,000 lb. It contains a 46-kv incoming disconnecting switch, an oil circuit breaker, lightning arresters, a power transformer, and three outgoing 15-kv metal clad switch-gear circuit breakers and feeders, which include potential and current transformers for metering and relaying. An auxiliary generator with control equipment is provided to supply auxiliary power, heat, and light while the unit is being readied for service. On one end of the car is the storage compartment containing tools required for maintenance and repair, and also such spare parts as bushings and lightning arresters. The unit is rated at 1800-kva with a high voltage of 35,000 v, which can be stepped down to 3150 or 6300 v. While being moved on American railroads, the trucks on the car are standard, American gage, but wider Russian trucks are being shipped with the unit to be installed at the port of entry.

Where Processes Call For CLOSE CONTROL

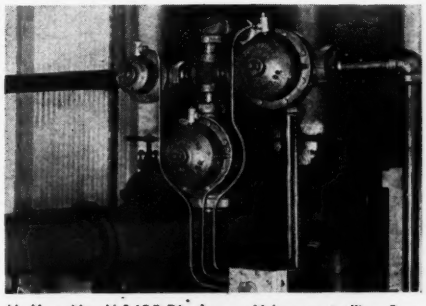
. . . Industry calls on McALEAR



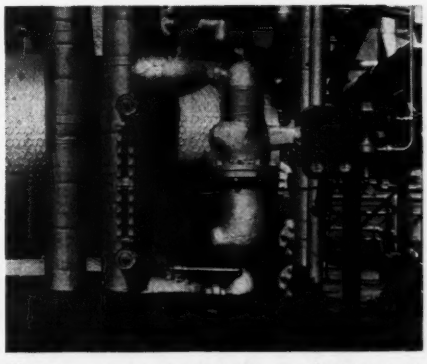
McAlear Type H-86 Motor Diaphragm Valve on gas line in prominent Texas oil company plant.



McAlear M-110 Motor Diaphragm Valve controlling saturated steam pressure to wire rubber-processing machines.



McAlear No. M-1455 Diaphragm Valves controlling flow and rinse cycles in critical industrial operation.



Close-up view of insulated McAlear Type H-850 Liquid Level Control on refinery reboiler.

IN PROCESS INDUSTRIES, particularly, advanced new methods employ abnormally high pressures and temperatures.

These call for new control instruments of greater sturdiness and higher precision—not only to withstand the severe operating conditions—but to give *closer control* of flow, temperature and pressure, where formerly tolerated variations would cause serious losses.

In many leading plants processing high octane gasoline, synthetic rubber, resins, plastics, chemicals, etc.—wherever ruggedness, dependability, high accuracy and low maintenance are prime control requirements—McAlear Controls today are valued for their part in maintaining continuous, uninterrupted production.

BRING YOUR CONTROL PROBLEM TO McALEAR. Draw on the wide experience of McAlear engineers . . . on their readiness and willingness to help you. For informative bulletins or catalog, write McAlear Manufacturing Company, Automatic Control Division of Climax Industries, 1915 South Western Avenue, Chicago 8, Illinois.

CLIMAX INDUSTRIES

McALEAR

PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE

controls

for STEAM, WATER, AIR, OIL—GAS

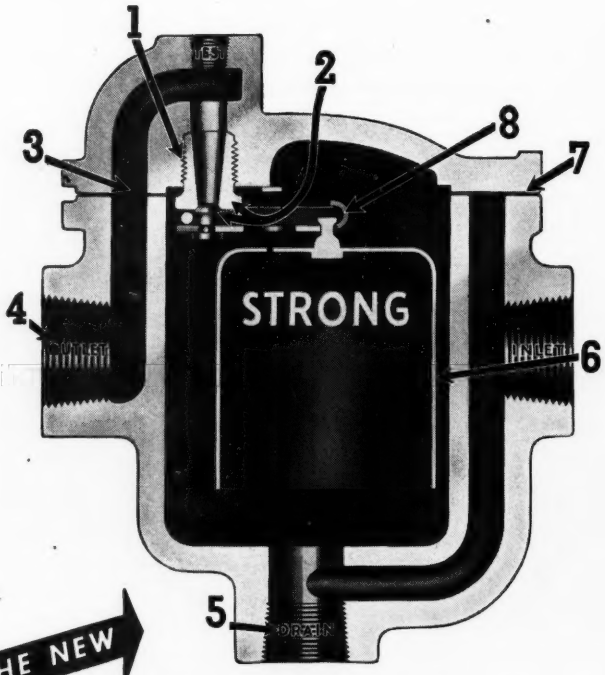
Eight Improvements

GENUINE make STRONG 70 Series Traps Better than Ever!

Look at these new features:

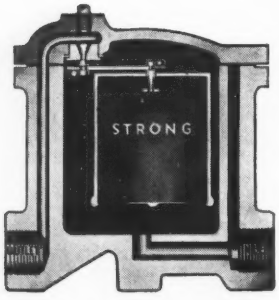
1. Renewable seat replacing pressed-in design;
2. Anum-Metl* valve and seat with new scientifically designed Hi-Cap* (patent applied for) orifice . . . up to 25% greater capacity;
3. Oversize inlet and outlet ports—increased flow capacity;
4. Relocated inlet and outlet connections—avoids backflow on light loads;
5. Drain connection added—available for bottom inlet;
6. One-piece, deep-drawn, stainless bucket—no welds;
7. Larger gasket area—means positive seal;
8. New, improved, stainless, high-ratio leverage.

Plus Adaptability to older models with change-over assembly including Hi-Cap orifice.



New 70 Series Strong Trap, No. 170

COMPARE THE NEW WITH THE OLD



Old 70 Series Strong Trap

In improving the 70 Series trap, Strong has remembered the thousands of older style 70 Series traps still in service after many years. Each improvement bears the "proof in service" label, so Strong quality remains uniformly high. Service continues to be available on all Strong traps, and they can be completely modernized to include the improvements listed above.

With a complete line of Strong open and inverted bucket traps at their disposal, Strong engineers can specify exactly the right type of trap for your particular application. For full details, write for the new Strong Catalog No. 67.

STRONG, CARLISLE & HAMMOND COMPANY, Cleveland 13, Ohio

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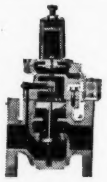
REG. TRADE MARK OTHER ANUM-METL Reg. Trade Mark **STRONG STEAM SPECIALTIES**

Strainer

No. 80 Series Trap



Reducing Valve

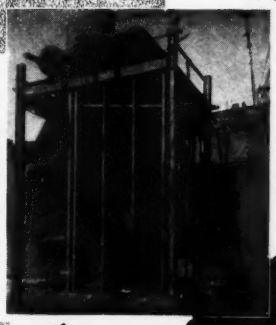
Vogt

PRODUCTS ARE

★ DESIGNED to RAISE
★ OPERATING STANDARDS and
★ LOWER YOUR COSTS

Drop Forged for Safety and Economy under the Most Trying Conditions

Valves, Fittings and Flanges by Vogt—the choice of operating men everywhere for safe and sure regulation of the high pressure and high temperature liquids and gases used in modern process work.



High Operating Efficiencies and Low Maintenance Costs

More steam per dollar of investment—because Vogt steam generating equipment is designed and built to fit in with specific operating conditions. Vogt boilers are available in bent tube types and straight tube, forged steel sectional header types for solid, liquid, or gaseous fuels, as desired. Three-drum types can be supplied to fit any conditions of restricted installation space.

Meeting the Demands for Operating Security

Vogt has every facility for the fabrication of stills, towers, continuous rotary filters, filter presses, oil chilling machines, heat exchangers, etc., and these products are serving the petroleum industry around the world.

Vogt

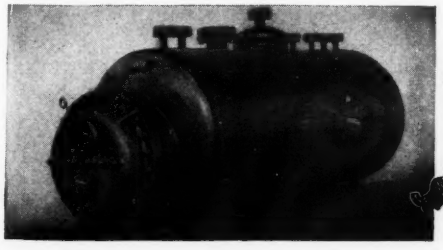
PRODUCTS

For Oil Refineries, Chemical Plants, Power Plants and Related Industries

HENRY VOGT MACHINE CO.

LOUISVILLE, KENTUCKY

NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS



To Combat Corrosion and Product Contamination

Process equipment made from special metals and alloys for the exacting service of the chemical plant is fabricated in our modern shops for many of the well known chemical companies.

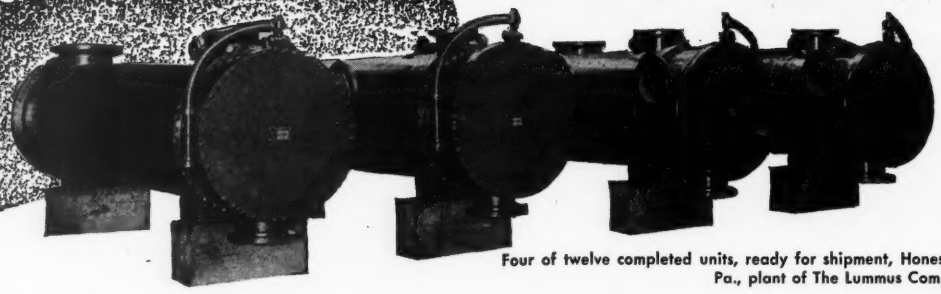
Steps Tonnage Up and Costs Down

Our experience of more than 50 years in building profit-making ice and refrigerating machinery is at your command. We make complete units for ice and cold storage plants, packing plants, dairies, breweries, chemical plants, oil refineries, etc.

Accurate alignment during assembly facilitates removal of tube bundles from shells.

A Major Refiner *selects* LUMMUS PROCESS CONDENSERS

ON PERFORMANCE RECORD OF *54 units*



Four of twelve completed units, ready for shipment, Honesdale, Pa., plant of The Lummus Company.

● Because of the outstanding performance at maximum loads of 54 Lummus Process Condensers having a total surface of 178,740 sq. ft. — operating for the past two years in two of the world's largest Butadiene plants — a major refiner recently ordered 12 identical units for installation in a new plant. These installations were originally designed to meet a very special condensate temperature condition and only the long, varied experience and knowledge of performance gained in operation of other units justified their adoption in these vital war plants without extensive experimentation.

Simplicity of design is the key note of the plus performance and trouble free operation of this and all other Heat Exchangers designed and fabricated by Lummus Co.

Lummus engineering service includes the study of specific Heat Exchanger problems and equipment designed to meet your individual conditions.

For complete information write to: The Lummus Company, 420 Lexington Ave., New York 17, N. Y.

LUMMUS

HEAT EXCHANGERS

BETTER THAN EVER!

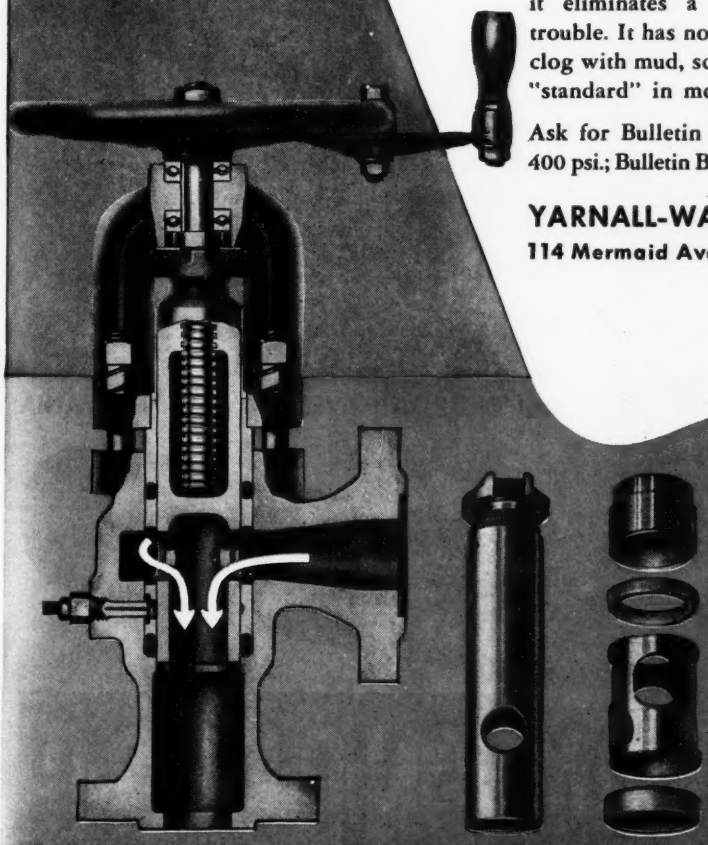
Constant metallurgical and mechanical research—aimed solely at improving boiler blowdown service—have made today's Yarway Seatless Blow-Off Valves literally "better than ever."

From the Yarway Research Laboratory have come such basic improvements as nitrided nitralloy sliding plungers and Neoprene-type packing rings. Both greatly increase the service life of Yarway valves . . . make them even more of a favorite among the nation's power plant operators.

The Yarway Seatless Blow-Off Valve has been hailed since its introduction because it eliminates a source of continuous trouble. It has no seat to score, wear and clog with mud, scale and dirt. Today it is "standard" in more than 12,000 plants.

Ask for Bulletin B-424 for pressures to 400 psi.; Bulletin B-432 for higher pressures.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.



SEE YARWAY BLOW-OFF VALVES ...HEAR LOWELL THOMAS describe their design and application in the new 30-minute color and sound motion picture "There Is An Engineering Reason." Free for group showings. Write for details.

YARWAY BLOW-OFF VALVES

TROY-ENGBERG
STEAM ENGINE

POWER IS MOST MODERN WHEN IT HAS LOWEST COST

The Troy-Engberg Steam Engine is industry's By-Product Power drive and for many plants it could be their most modern equipment . . . producing power at very low cost since the exhaust carries such a high percentage of the heat units needed for heating or processing.

In many plants the Troy Engine is producing power at a cost well under that of any other unit. In fact, it often pays for itself completely within a year or two, driving such commonly-used equipment as stokers, compressors, blowers, pumps, generators, fans, cookers and dryers.

We suggest that you investigate thoroughly the role the Troy Engine could fill in your plant. Steam for heating or processing and need for power are determining factors . . . if you have these requirements, you probably have a place for this modern steam engine.

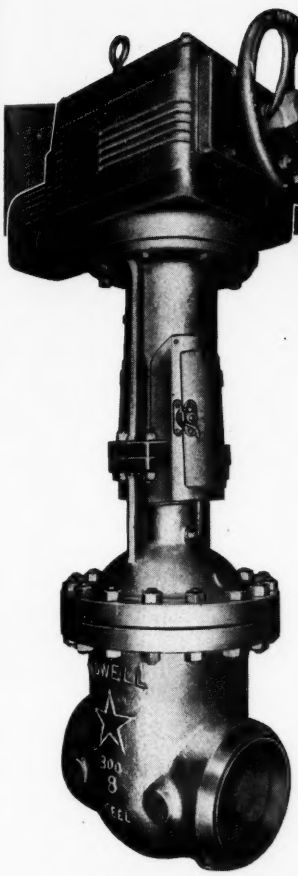
TROY ENGINE & MACHINE CO.
Established 1870
884 RAILROAD AVE., TROY, PENNSYLVANIA

SEND FOR OUR BULLETIN 306. IT WILL GIVE YOU ESSENTIAL INFORMATION ABOUT THE TROY-ENGBERG STEAM ENGINE.

BULLETIN
306

TROY-ENGBERG
STEAM ENGINES • GENERATING SETS • GENERATORS

POWELL VALVES for Power Plants



Class 300-pound, 8" Cast Alloy Steel, Welding End Gate Valve. An Electric Motor Operator is mounted on top for quick, positive opening and closing of the valve by remote control.

100 YEARS ago Powell started making valves for industry and today a century of practical experience and continual scientific research lies behind every Powell Valve. Powell has never specialized in making valves of any particular type or material but through these hundred years Powell *has* specialized in making valves only—valves to meet the flow control requirements of every service in every branch of American Industry.

The Powell Line of Valves for Power Plants includes Bronze and Iron Valves of all necessary types and sizes for the lower pressures and temperatures and a complete line of Cast Steel Valves of all types, including Non-return, for pressures from 150 to 2500 pounds. Electric Motor Operators for remote control can be provided for all Powell Cast Steel Gate, Globe, Angle and Non-return Valves.

The Wm. Powell Company, Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

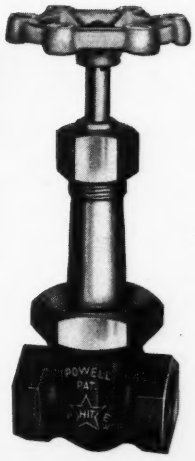


Fig. 375—200-pound Bronze Gate Valve with screwed ends, union bonnet, inside screw rising stem and renewable, wear-resisting, taper wedge disc. In sizes ¼" to 3", inclusive. Also available with flanged ends (Fig. 376) in sizes ¾" to 3", inclusive.

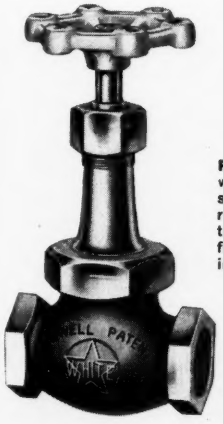


Fig. 1708—200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable seat rings and regrindable, renewable, wear-resisting semi-cone plug type disc. In sizes ¼" to 3", inclusive. Also available with flanged ends (Fig. 1702) in sizes ½" to 3", inclusive.

Fig. 241—Iron Body Bronze Mounted Globe Valve for 125 pounds W. S. P. Flanged ends, outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc. Available in sizes 2" to 16", inclusive.

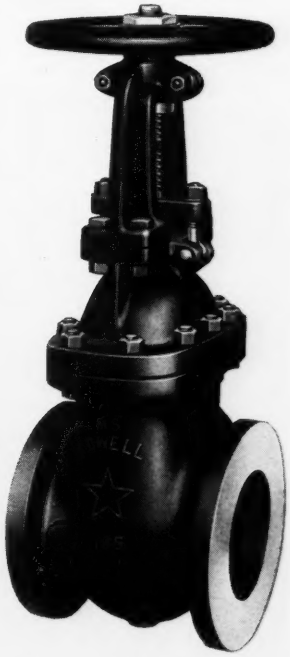


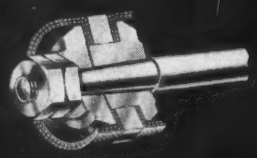
Fig. 1793—Iron Body Bronze Mounted Gate Valve for 125 pounds W. S. P. Flanged ends, outside screw rising stem, bolted flanged yoke, bronze seat rings and taper wedge solid disc. Sizes 2" to 30", inclusive.

POWELL VALVES

AHEAD OF THE FIELD

Warren "Realwear" Steam Pumps

WARREN MOLDED PISTON CUP PACKING



THE DURABLA VALVE

Completely open under full load

Partially open under light load

4 new standard features at no extra cost!

Yes, Molded Piston Cup Packing, Stainless Steel Durabla Valves, Stainless Steel Piston Rods and All Steel Valve Gear (Bronze Bushed), are now *standard* features on Warren Horizontal Duplex Piston Pumps—"Realwear" Type! Standardization of these features . . . in addition to the many other advantages of "Realwear" design . . . gives you a pump that is far and away the leader in its field. Here are the advantages:

WARREN MOLDED PISTON CUP PACKING

Greater efficiency and lower operating costs because of minimum slippage . . . and longer liner life because of less wear when these cups are used.

Repacking made easier.

Much longer life of cups compared to ring packing.

Successfully handles practically all liquids . . . including hot water to 250° maximum at pressures to 1000 lbs. maximum . . . with standard cups and higher temperatures and pressures with special cups.

STAINLESS STEEL DURABLA VALVES

Achieve instant adjustment to variations in load; open only enough to allow passage of the flow; close instantly; eliminate slip; reduce cavitation, turbulence, and friction losses to a minimum; and permit pumps to operate at full load at slower speeds.

STAINLESS STEEL PISTON RODS

Insure maximum resistance to corrosion and wear.

ALL-STEEL VALVE GEAR (Bronze Bushed)

Adds strength and length of life to this constantly moving and important part of the pump.

Write for information

WARREN PUMPS

WARREN STEAM PUMP COMPANY, Inc., Warren, Mass.

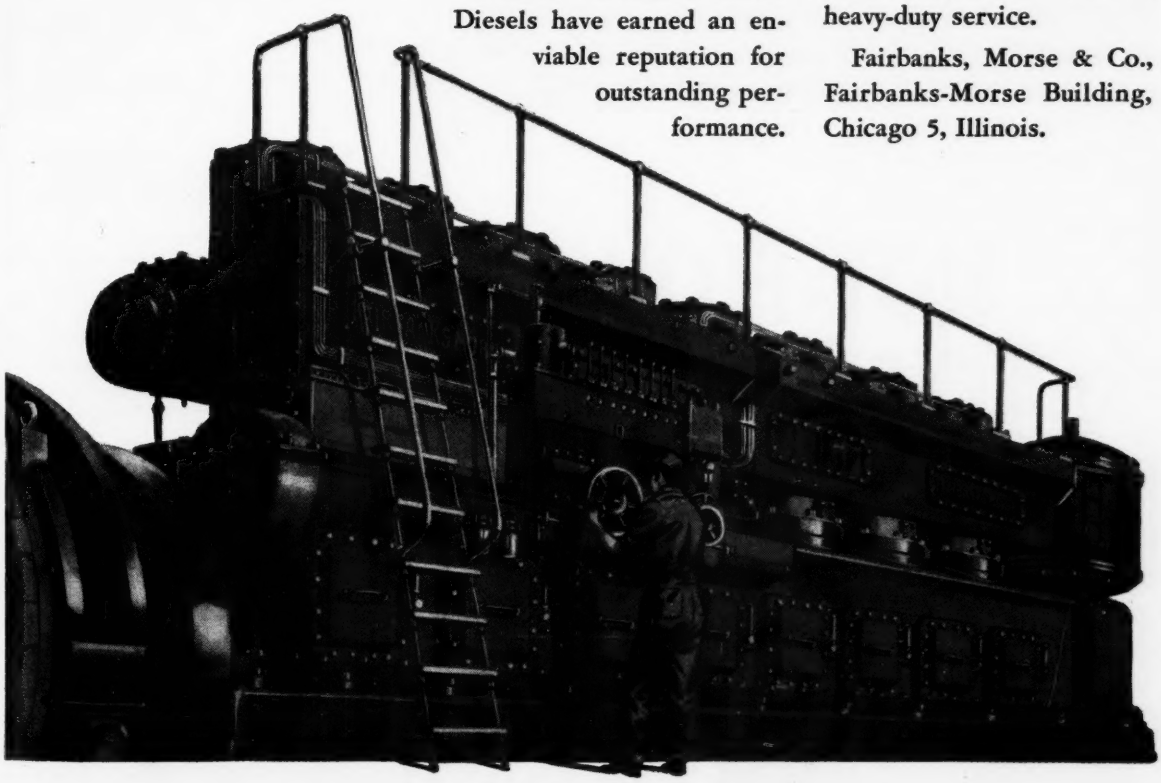
WORTH REMEMBERING

see Fairbanks-Morse FIRST FOR DIESELS

One of the first Diesel engine manufacturers in this country, Fairbanks-Morse has pioneered a notable list of Diesel improvements. As a result, Fairbanks-Morse Diesels have earned an enviable reputation for outstanding performance.

Their operating records prove their low operating costs and low maintenance costs... prove, too, that they have the stamina to stand up year after year in sustained, heavy-duty service.

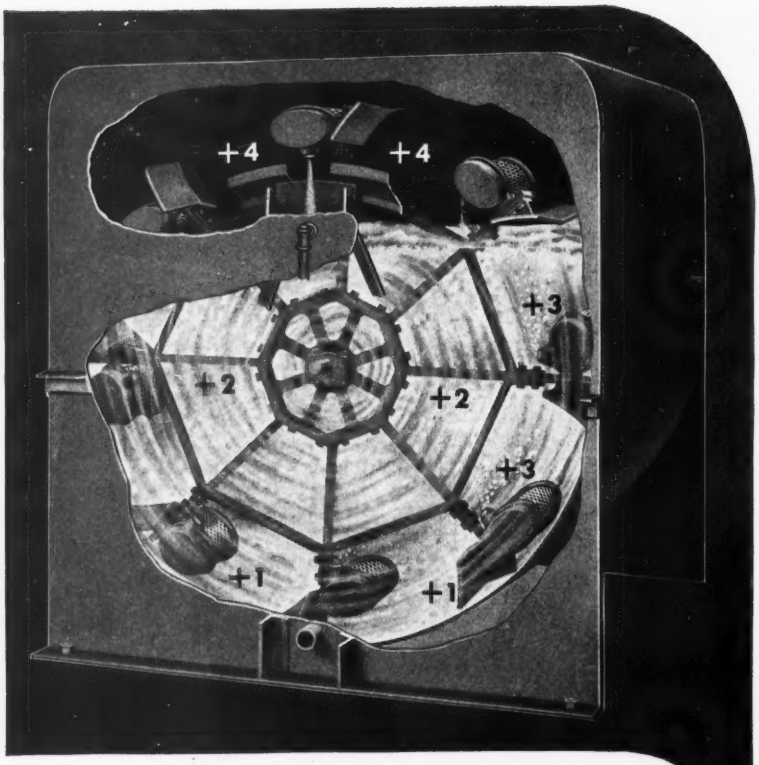
Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.



Fairbanks-Morse

A name worth remembering

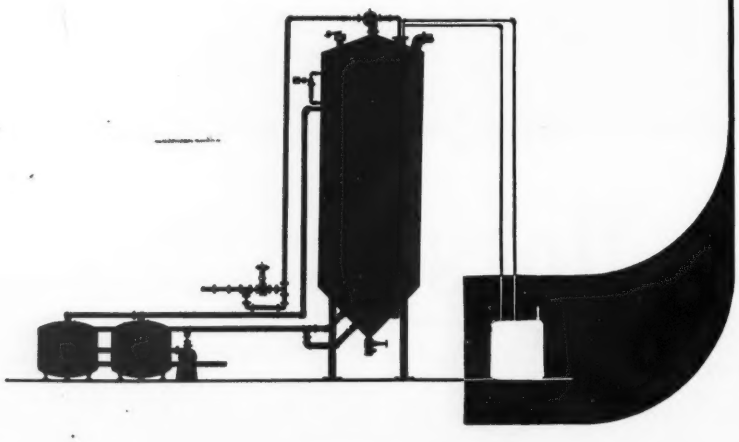
Diesel Locomotives • Diesel Engines
Scales • Motors • Pumps • Generators
Magnetos • Stokers • Railroad Motor Cars and Standpipes • Farm Equipment

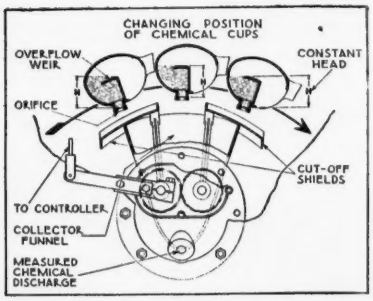


INFILCO CHEMICAL MIXER AND FEEDER

HOT-FLOW SOFTENERS

CONVERT WATER INTO BOILER FEED





A constant head over a constant orifice in any discharge position.

INFILCO Chemical Mixers and Feeders contribute greatly to the enviably successful operation of Hot-Flow Softeners.

Their function is to hold a chemical solution, or mixture, at a uniform strength—and, to feed it accurately.

They are doing just that—year after year—because of the cumulative effects of these plus value design features—

+1 The half-rounded bottom—with plow-shaped agitators sweeping close—eliminates dead spaces where any solids can deposit.

+2 Agitators—revolving vertically—circulate the mixture in a positive up and down motion. Stratification is impossible.

+3 As the cup moves down, trapped air escaping from its discharge orifice, blows out obstructions—keeping the orifice clean.

+4 Every chemical cup is designed to maintain a constant head over the orifice during the entire period of discharge.

And the cumulative results are—

+1 + +2 = *Uniform Solution or Mixture.* Samples, taken at random from the Mixer and Feeder, will never vary in chemical content more than 1½%.

+3 + +4 = *Accurate Feeding.* A constant head over a constant sized orifice is a precise means for feeding an unvarying volume of solution.

Not only the Infilco Mixer and Feeder, but also every other component part of the Hot-Flow Softener, has plus value features—every one of which contributes to smoother and more efficient operation. That's why Hot-Flow softening for boiler feed is hot process softening plus.

INFILCO

INFILCO

INCORPORATED

325 WEST 25TH PLACE, CHICAGO 16, ILL.

BELIEVE IT OR NOT . . . IT'S ONE PIECE!

This heavy, curved welding neck looks like several fittings welded together. That would be the easy way to make it, but the particular condition it serves requires a one-piece forging.

Turning out a hollow forging like this—involving a flanged, curved, and upset section—is a tough undertaking. And yet it is typical of the kind of jobs that many people feel we are better qualified to handle than any other forging plant.

Yes, doing things with hot metal that nobody else does—knowing how to control its flow under pressure and impact — has been our specialty here for a good many years.

It is the "know-how" acquired in these special undertakings that explains why we are able to make WeldELLS and other Taylor Forge welding fittings, the fittings that have "everything" . . . why you find in WeldELLS extra metal properly distributed where service stresses are greatest . . . why WeldELLS have tangents . . . why all dimensions are so extremely accurate.

Just check the list of features, opposite, and we believe you will agree that WeldELLS indeed have everything conducive to sound engineering and utmost economy in every pipe welding job.

No other fittings for pipe welding combine these features found in WeldELLS:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

WeldELLS *have everything*

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
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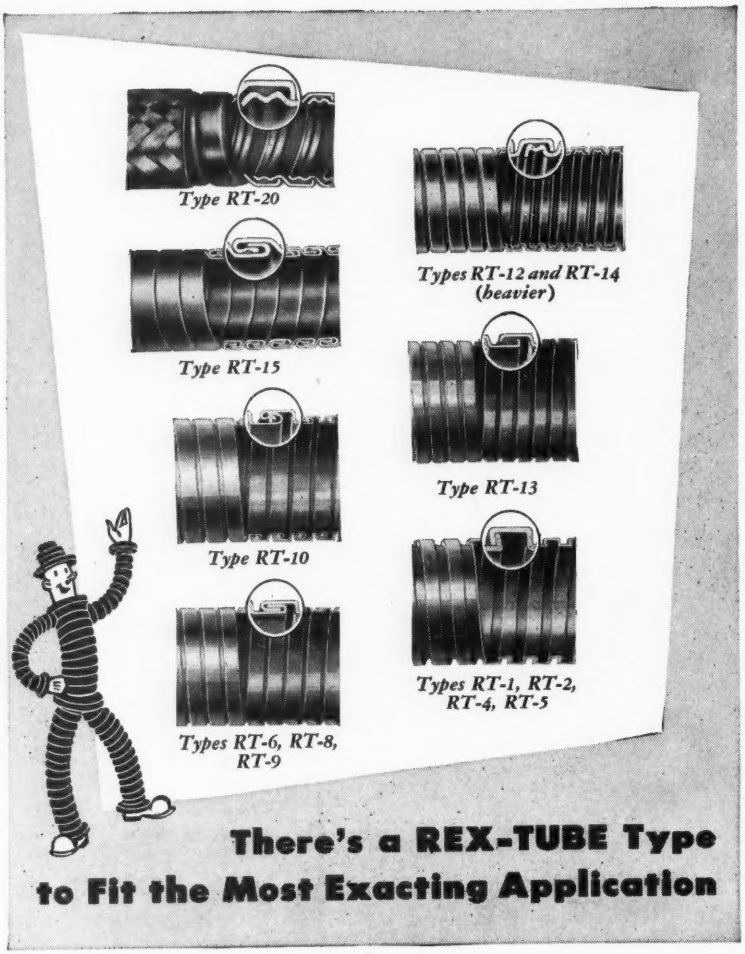

Type RT-20
Types RT-12 and RT-14 (heavier)
Type RT-15
Type RT-13
Type RT-10
Types RT-1, RT-2, RT-4, RT-5
Types RT-6, RT-8, RT-9
There's a REX-TUBE Type to Fit the Most Exacting Application

Rex-Tube isn't a cure-all, of course. But within its capacity this rugged, flexible metal hose will handle efficiently and economically just about anything you give it to do. There are sizes and types, for example, that range from oil can spouts . . . to heavy duty tubing used in steaming out tank cars.

Production men throughout industry know that many of their exacting problems can be solved with Rex-Tube or with the other flexible metal hose products in the complete C.M.H. line, including: Rex-Weld, Rex-Flex S.S., Avioflex and Cellulined. We can help you, too! Write today for Booklet E-144.

Flexible Metal Hose for Every Industrial Use

ARMY E NAVY

CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

Obituaries

Frank F. Fowle

Frank Fuller Fowle, since 1920 the head of Frank F. Fowle & Co., consulting engineers of Chicago, died January 21 of a heart attack at his home in Winnetka, Ill., after a day's work at his office in Chicago.

Mr. Fowle was born in San Francisco, Calif., Nov. 29, 1877, and received his college education at Massachusetts Institute of Technlogy having been graduated with the degree of SB in EE in 1899. His early professional work was with the American Telephone and Telegraph Co. in New York City, then in Chicago. From 1908 to 1912 he engaged in consulting engineering work in Chicago, then took up editorial work on the Staff of Electrical World in New York for two years and from 1914 to 1919 was receiver for the Central Union Telephone Co. operating in Ohio, Indiana and Illinois.

Upon establishing his own consulting engineering company in 1920 his practice dealt with electrical and mechanical engineering problems, research and development work, valuation, ratemaking and depreciation studies, and engineer witness in court cases. He was editor-in-chief of the Standard Handbook for Electrical Engineers and has contributed many technical papers and reports to societies and the industrial press. He was an active member of AIEE, president of Western Society of Engineers 1935-1936, member of the Illuminating Engineering Society, American Society for Testing Materials and active in several civic and social organizations. As president of the Illinois Engineering Council he was instrumental in securing the passage of The Illinois Professional Engineering Act and has served on the Examining Committee since the law went into effect July 20, 1945.

Two sons, Frank F. Jr. of Winnetka, Ill., and Lt. (j.g.) William Fowle, now stationed in Washington, D. C., survive Mr. Fowle, his wife having died in 1944.

NEWS *from* THE FIELD

Midwest Power Conference

THE MIDWEST POWER CONFERENCE will be held in Chicago next April under the sponsorship of the Illinois Institute of Technology, after a lapse of one year due to war restrictions. Stanton E. Winston, conference chairman, states that the 1946 meeting has been enlarged to three full days, April 3, 4 and 5 with headquarters at Palmer House, so that many recent and important developments in the power field may be included.

Plans for the conference include for

Crystolon Brick

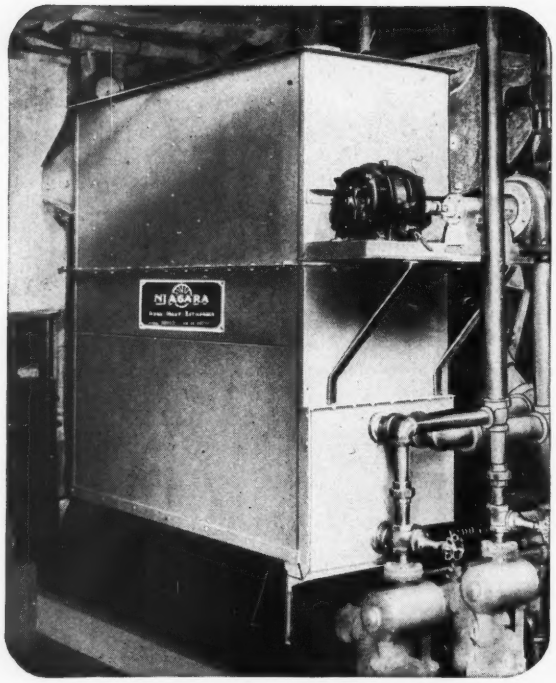
for LONG LINING LIFE

If you want uninterrupted boiler furnace operation with avoidance of costly "down-time" for lining repairs, then select CRYSTOLON Brick. These densely constructed silicon carbide brick stand up even at the highest temperatures and they are resistant to abrasion and to the penetration and erosive action of slag.

CRYSTOLON Brick are not damaged by clinker removal, thus their surface remains clean and unaffected for long lining life. (The installation pictured above shows CRYSTOLON Brick still in excellent condition after 12 years of service.)

NORTON COMPANY
WORCESTER 6, MASSACHUSETTS

Norton Refractories



Trustworthy Water Jacket Cooling for Industrial Power Equipment

Ample cooling capacity, with freedom from the maintenance troubles of open-system water cooling, supports higher production.

The NIAGARA AERO HEAT EXCHANGER provides a closed system of re-circulated, clean jacket water at a controlled temperature. Operating your diesel or gas engines or other machinery at the correct temperature assures you of full-rated power, and freedom from frequent shut-down and mechanical trouble.

Using the NIAGARA AERO HEAT EXCHANGER also provides operating economies that quickly pay for the equipment. The heat is removed by air and the high cost of cooling water is eliminated.

Write for Bulletin 96 for complete information.

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

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Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

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HUMIDIFYING • AIR ENGINEERING EQUIPMENT

the first time a session on the gas turbine, which has assumed an increasingly important position in recent years due largely to war-time developments. Applications of atomic energy in the post-war power world will also be discussed by this group. Papers being prepared will deal with industrial power plants, hydro power, feedwater treatment, recent developments in the fields of heating and air-conditioning, fuels and combustion, central station practice, industrial loads supply, Diesel power, insulation problems on power systems, and recent electrical developments.

As in the past, nine midwest colleges and universities and several engineering societies will co-operate with Illinois Institute of Technology in the sponsorship of the 1946 conference. The University of Illinois, University of Michigan, University of Minnesota, University of Wisconsin, Northwestern University, Purdue University, State University of Iowa, Iowa State College and Michigan State College make up the group of co-operating educational institutions.

Exposition of Chemical Industries

THE 20TH EXPOSITION OF CHEMICAL INDUSTRIES is being organized for the week of February 25 to March 2 in Grand Central Palace, New York, lately occupied as an army induction center. The announcement was made by Charles F. Roth, president of the International Exposition Co., under whose management the show of raw materials, processing equipment and chemical products is to be held.

Coming at a time when industries are in the throes of reconversion the exposition will serve as an accelerator, providing opportunities for personal contact and business conferences between principals, technical staffs, manufacturers and professional consultants. Many new products and processes created by the war are expected to come out from under wraps and be applied to civilian operations, now that military needs no longer demand secrecy. Many other new methods and products, shelved during the war years, are emerging as by-products, intended to round out the economic formulas. To the stimulating influence of first-time disclosures will be added the substantial effect of exhibits of improvements by many of the most influential concerns in process equipment and chemical research fields.

Chinese Engineers Study U. S. Power Projects

TWENTY-FIVE YOUNG Chinese engineers are studying the multiple-purpose projects of the Bureau of Reclamation in a training program to prepare themselves for an active role in developing China's natural resources.

Six members of the group recently arrived from China are now in the Washington office of the Bureau and

EVERY POWER *and* MARINE ENGINEER

should have this Bulletin!

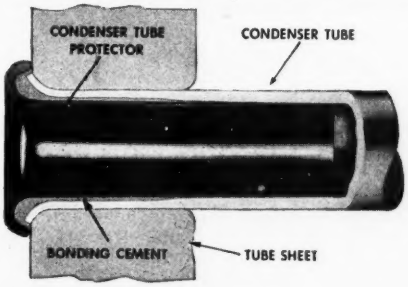
IT TELLS HOW

JOHN CRANE

CONDENSER TUBE PROTECTORS

Prolong Tube Life!

DESIGN FEATURES: **Bell mouth, streamlined entrance (left) is designed for minimum turbulence; maximum water flow. Thin discharge end (right) fits tube surface tightly, eliminating pressure drop-off and further water turbulence. Molded of hard, thermo-setting plastic, highly resistant to abrasion and erosion.**



DON'T discard condenser tubes simply because of inlet end erosion or thinning! The new bulletin shown above tells how JOHN CRANE Condenser Tube Protectors:

- **Stop all inlet end damage**
- **Last for life of tubes**
- **Quickly pay for themselves**

These Tube Protectors are easy to install, and have been used with great success on all types of heat exchanger installations, on old or new tubes. Millions in use by the U. S. Navy.

All Power, Marine and Condenser Maintenance Engineers should see this new bulletin. It's interesting and informative—*write for a copy!*

Crane Packing Company • 1812 CUYLER AVENUE CHICAGO 13, ILLINOIS

Amarillo, Baltimore, Boston, Buffalo, Cleveland, Detroit, Houston, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Seattle, Shreveport, Tulsa

• Insulation where you don't want it – and worse yet, where you can't see it – in the form of slime deposits on heat transfer surfaces, may be actually costing you thousands of dollars annually. A slime coating – even a film that's barely visible – will insulate condensers so they cannot function at rated capacity. And that may raise your producion costs disastrously.

Mechanical cleaning is not the answer. Not only is it a slow, laborious process, but it's costly to take condensers "off the line" periodically for this outmoded method of cleaning.

That is the reason so many plants are employing W&T Chlorination. Slime deposits already present are removed without shutdowns and their recurrence prevented, insuring a continuously slime-free cooling system.

Wallace & Tiernan chlorinating equipment is engineered to meet the specific needs of each individual plant, and W&T engineers will gladly recommend the most practical method of chlorine application for slime control in *your* plant.

WALLACE & TIERNAN PRODUCTS, INC.

Manufacturers of Chlorine and Ammonia Control Apparatus

Belleville 9, N. J. • Represented in Principal Cities

CD-20S

19 others are studying under the direction of Reclamation engineers at Denver.

In carrying out this training the Bureau is co-operating in a program originally initiated by the Foreign Economic Administration to assist the war effort in the Pacific. The program is now being carried on by the Chinese Government with the assistance of the International Training Administration.

The engineers now completing an orientation course in irrigation and hydroelectric power construction are all graduates of Chinese universities and hold engineering degrees with special emphasis on hydraulics. They are in an age group of 28 to 33 and have had an average of about 6 yr practical experience in engineering work in China.

Washington Award to Vannevar Bush

THE WASHINGTON AWARD Commission has elected Dr. Vannevar Bush, President, Carnegie Institution of Washington, as the recipient of the Award for 1946. The Award is "for outstanding leadership in organizing and directing the scientific resources of the nation toward victory in World War II."

Dr. Bush will be the principal speaker at the presentation meeting, and his subject will be "Science and the War Effort."

The presentation will be made at a joint meeting of the participating societies on February 20 at the Palmer House in Chicago.

John Fritz Medal to Dr. Zay Jeffries

DR. ZAY JEFFRIES has received the 1946 award of the John Fritz Medal for "leadership in the solution of problems affecting the production, conservation, substitution and the scientific appraisal of metals and alloys." The John Fritz Medal, established in 1902 by the great professional societies of civil, mining and metallurgical, mechanical, and electrical engineers, therefore often called "the highest award in engineering," is given for notable scientific or industrial achievement, and is international in scope, having been awarded to Lord Kelvin, Sir Robert A. Hadfield, Marconi, as well as to the great American leaders, Westinghouse, Bell of telephone fame, Edison, Elihu Thomson, General Goethals, Orville Wright, Sperry, Herbert Hoover, Whitney, Kettering and others.

Expansion Work at Grand Coulee

THREE COMPANIES have begun construction of parts for three new 108,000 kilowatt generators for Grand Coulee Dam.

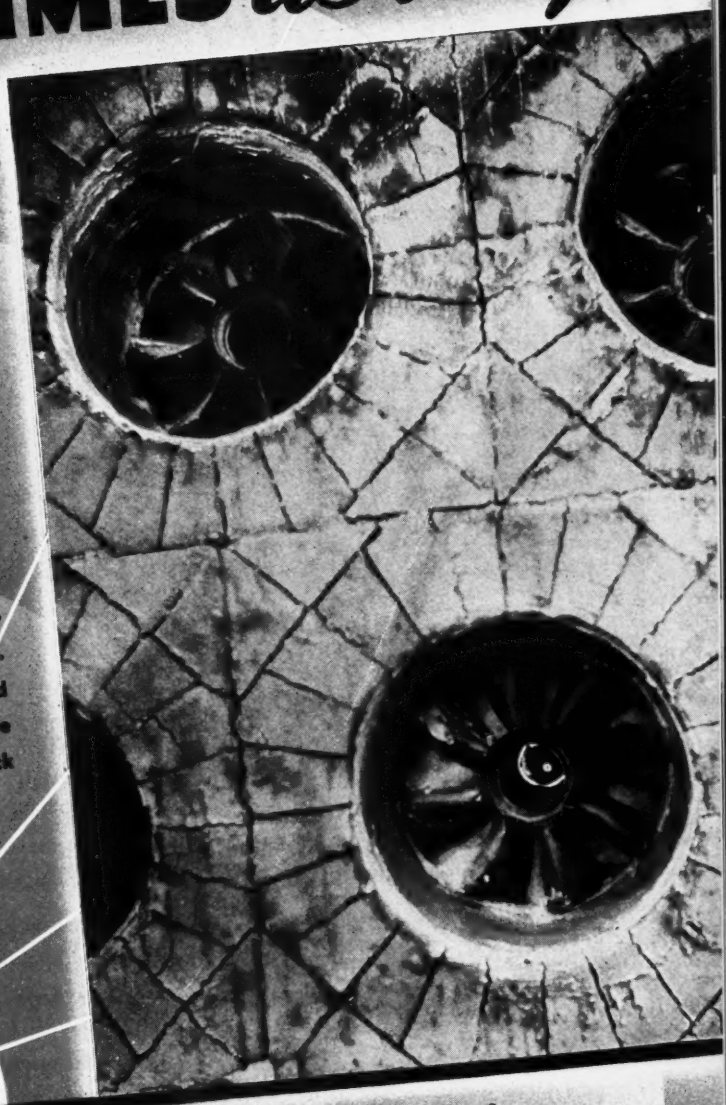
When installed, the units will cost approximately $2,000,000 each and will give Grand Coulee Dam a capacity of 992,000 kw.

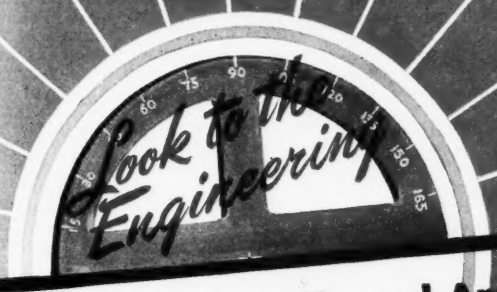
The new units, together with six mates of equal size, are the largest hydroelectric generators in the world and are intended to serve the world's biggest pumps besides supplying electricity for Northwest homes and industries. The pumps, to be installed

When BURNER RINGS *last* 3 TIMES *as long...*

The service they went through was terrific—24 hours a day . . . 7 days a week . . . no let-up . . . plus capacity . . . full head of steam . . . no time for shut-down. They took the punishment . . . they delivered. When burner rings last 3 times as long under that kind of service, look to the engineering.

The unretouched photograph here shows a set of burner rings—Detrick Burner Rings that have been in use three times the normal span of life for burner rings. Performance like this is visual evidence of the soundness of Detrick engineering—practical engineering that knows materials and how to use each for its best function. In this case the principle of sectionalizing and individually suspending the tile is responsible for the long life of the rings and the Detrick Wall and Arch that went with them.





Detrick Walls and Arches in Post-War Operation

Now is the time to get your post-war plan on the boards. Let us look over your blueprints and make suggestions for improvements and modernizing that can be made in the immediate future, providing greater capacity or higher efficiency from your present equipment. Detrick Suspended Walls and Arches will continue to give plus service in peace time as they have before and during the war, adding to the lives of furnace enclosures and saving money for their owners. Ask for our new catalog "Detrick Furnace Enclosures."

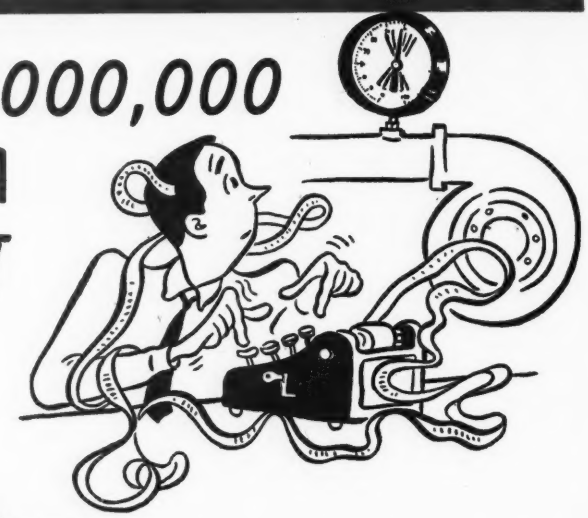
M. H. DETRICK COMPANY
111 West Washington St., Chicago 2, Ill.

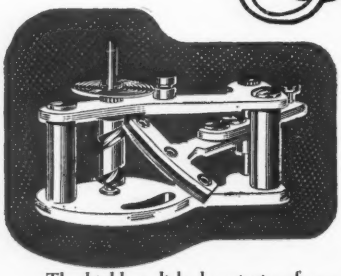
If it's a problem of enclosing heat, it's a job for Detrick

DETRICK FURNACE ENCLOSURES

USE DETRICK INSULATION . . . PLASTIC or BLOCK

75,000,000 IS A LOT





The highly polished contact surfaces of the graphited Bakelite cam and the bronze helicoid roller account for the unusual wearing qualities of the Helicoid movement.

75 million is a lot of anything. And when any pressure gage withstands 75 million cycles of operation, that represents a lot of gage service.

To determine how much longer Helicoid Gages with Helicoid movements would wear than ordinary gages with spur geared movements, an endurance test was run by an independent testing laboratory.* Two of the best spur-geared movement gages were tested against Helicoid Gages.

All gages were pulsated at the rate of 1200 cycles per minute. One gage failed after 500,000 cycles because the stainless steel teeth were worn away. The other gage failed after 10,000,000 cycles. After 75,000,000 cycles (as of Sept. 5, 1945), the two Helicoid Gages were still operating, and were within an accuracy of ½% and 1% respectively.

This proves that the Helicoid movement greatly outwears spur geared movements and that Helicoid Gages remain accurate long after ordinary gages are worn out.

If your service cost on pressure gages is high, it will pay to switch to Helicoid Gages.†

*U. S. Testing Co., Inc., Hoboken, N. J. See report 42592.

†Formerly called "Certified."

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HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE
BRIDGEPORT 2, CONNECTICUT

TRADE MARK

upstream near the west abutment to Grand Coulee Dam, will provide water for the Columbia Basin Irrigation Project, largest ever planned in the United States.

The generators will be constructed by the Westinghouse Electric Corp., East Pittsburgh, Pa., the governors will be built by the Woodward Governor Co., Rockford, Illinois, and the 150,000 horsepower turbines by the Newport News (Va.) Shipbuilding and Dry Dock Co.

Installation of the three new units will complete the capacity of the powerhouse on the west bank of the Columbia River below Grand Coulee Dam. This powerhouse now has six 108,000 kw generators, two 75,000 kw generators, and two station-service units of 10,000 kw each. The 75,000 kw generators, assigned to Grand Coulee Dam during the war, will be removed prior to installation of the larger units. The 75,000 kw generators will be shipped to the Bureau's Shasta Dam in California.

Still awaiting generators and turbines is Grand Coulee Dam's east powerhouse which is capable of handling nine 108,000 kw generators.

New Officers for Engineering Foundation

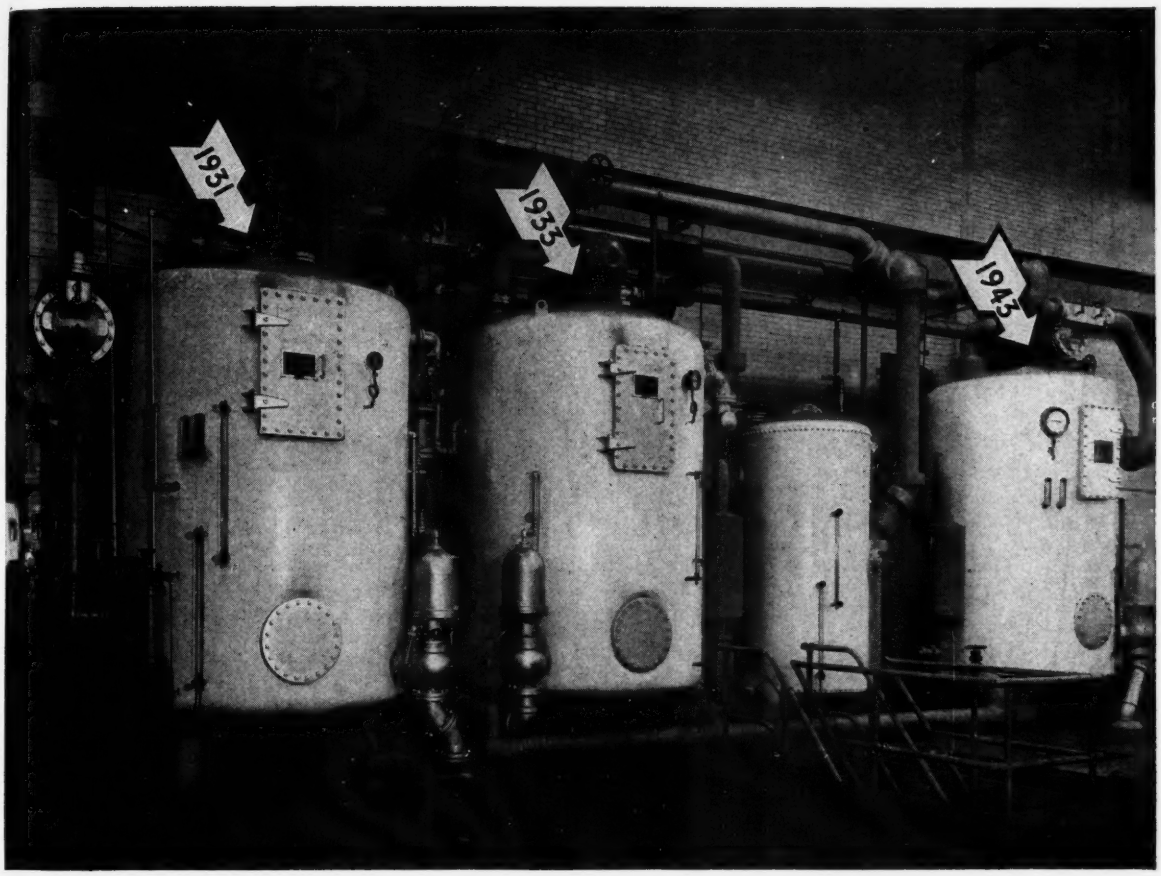
AT ITS ANNUAL MEETING held October 8, the Engineering Foundation elected Dr. A. B. Kinzel as chairman for the coming year. Dr. Kinzel, internationally known metallurgist, is vice-president of the Union Carbide and Carbon Research Laboratories, Inc., and of the Electro Metallurgical Co. He has been senior consultant of the Metals Branch of the War Production Board, and is now Chief Consultant on Metals to the Enemy Branch of the Foreign Economic Administration. His activities extend into the professional technical societies including the International Commission for Acetylene and Welding, and the Committee on Metals of the National Academy of Science. Other officers elected were vice-chairman Dr. L. W. Chubb, Director of the research laboratories of Westinghouse Electric Company; Dr. Edwin H. Colpitts, formerly Director of the Bell Telephone Laboratories was reelected director, and John H. R. Arms, reelected secretary. Dr. Kinzel will represent the Engineering Foundation on the Executive Board of the National Research Council.

During the year just ended, the Foundation has participated in research problems dealing with soil mechanics and foundations, critical pressure of steam boilers, plastic flow of metals, and cooperation with the Welding Research Council, Engineers' Council for Professional Development, and the National Academy of Sciences.

Parks Appointed Metals Society Editor

JOHN M. PARKS has joined the staff of the American Society for Metals as editor of technical books. Dr. Parks will also assist in the work of the Educational Committee and prepare lecture series for use by the 69 local chapter groups of the Society.

The Society's objective will be to coordinate the advances of the indus-



"AND NOW THERE ARE THREE—"

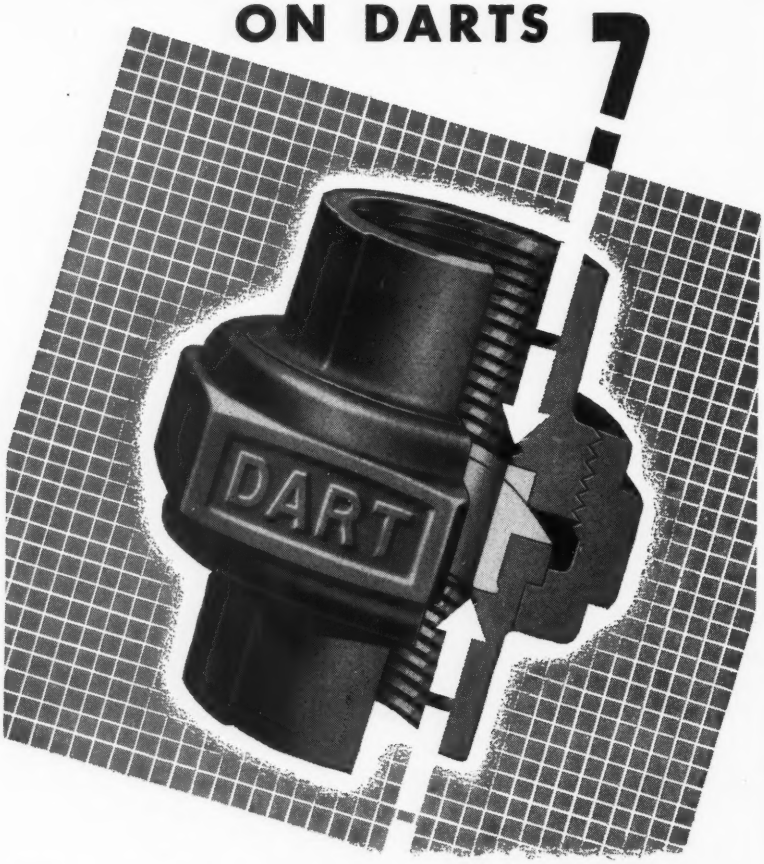
A NATIONALLY known manufacturer of a famous line of food products early in 1931 installed a Cochrane Deaerator of 200,000 lbs./hr. capacity to take care of their feedwater requirements. In 1933 they found their evaporation rate running higher than the capacity of the Deaerator, and ordered a second Cochrane unit of 200,000 lbs./hr. which was connected in parallel with the first. These units functioned with customary complete satisfaction, but in 1943, with the natural expansion of the business, the evaporation was found to be running well above 400,000 lbs./hr. So another 200,000 lbs./hr. Cochrane Deaerator was installed and the three units operate in parallel, giving a total heating and deaerating capacity of 600,000 lbs./hr. *The repeated purchase of Cochrane Deaerators to keep pace with growing needs is a tribute to continuous, consistent, satisfactory performance.*

COCHRANE CORPORATION ARMY E NAVY **3123 N. 17th ST., PHILADELPHIA 32, PA.**

COCHRANE

SOFTENERS · DEAERATING SOFTENERS · DEAERATORS · METERS · STEAM SPECIALTIES

IMPORTANT DATA ON DARTS



They Have Two Bronze Seats Ground To a True Ball Joint

The importance of this exclusive Dart feature is in that it permits the union to make a drop-tight connection without freezing the seats. Darts may be uncoupled instantly whenever needed for further service. Bodies and nuts are made of high-test air-refined malleable iron—are practically indestructible.

For long, trouble-free service —and consequent low cost— always specify Darts.

DART UNIONS

E. M. DART MFG. COMPANY, PROVIDENCE, RHODE ISLAND

try and present these in technical books prepared under the direction of Dr. Parks. The score or more of books now being published will also be revised and brought up-to-date under Dr. Parks' direction.

Dr. Parks received his Bachelor of Science degree in Chemical Engineering from Purdue University and his M.S. in Metallurgical Engineering and Ph.D. from Rensselaer Polytechnic Institute. Since 1939, he has been engaged in teaching and research at Rensselaer and had a varied part in the war research program of the Metallurgy Department.

Peak Expected in Production of Power Plant Equipment

THE NATIONAL INDUSTRIAL CONFERENCE BOARD reported that a new all time high in production of electric power plant equipment is expected in 1946, with utility companies anticipating that electrical energy requirements in 1947 will surpass wartime peak consumption.

Three factors are prominent in this optimistic outlook:

1. Anticipated expansion in electric production capacity.
2. Heavy demand for industrial electric equipment that will consume a large part of this power increase.
3. Prospects for extensions of service lines to agricultural areas in the next three years.

Rapid expansion of electric power production for war purposes was accomplished with a relatively small addition to plant and equipment. Consumption jumped 73 per cent while additions to plant and equipment amounted to only 26 per cent. Drastic changes in distribution methods were necessary to avoid serious power shortages. Normal competitive methods were abandoned and replaced by a gigantic power pool.

There is a need now for an extensive expansion program. This is reflected in the current heavy burdens placed on operating capacities of electrical equipment manufacturing plants.

Prices are expected to remain at current levels for the time being, although increased labor and overhead costs may subsequently force pressure for higher prices. Labor costs during the war increased as much as 35 per cent in some cases.

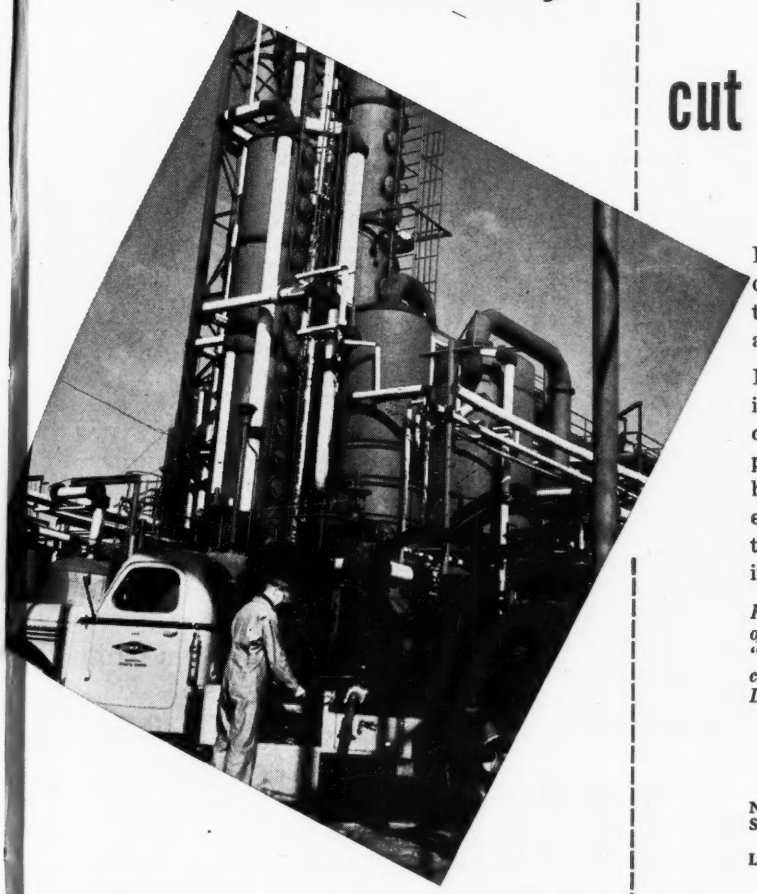
Research Laboratory for Liquid Fuels

PLANS ARE BEING COMPLETED for a new laboratory and research unit where the U. S. Bureau of Mines will conduct experiments in the production of gases required in the manufacture of synthetic fuel oil from coal. This laboratory will be established on the campus of the West Virginia University at Morgantown, W. Va.

The project will be carried out under a co-operative agreement be-

DOWELL

restore efficiency



cut operating costs

Leading refineries reduce operating costs and quickly restore designed operating efficiency through Dowell's *chemical method* of removing accumulated scale and sludge from heat exchangers.

Dowell specialists do the entire job. They pre-inspect the equipment to be cleaned. They chemically analyze samples of deposits found in *your* plant. And after this careful preparation they bring with them the proper chemicals and adequate equipment to completely *control* every stage of the treatment and to insure effective removal of the insulating deposits.

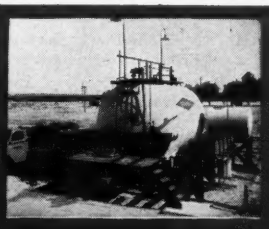
For complete details, call the nearest Dowell office for a free estimate. Ask for your copy of "More Power to America's Industry"—new color booklet which explains and illustrates Dowell's thorough chemical cleaning service.

DOWELL INCORPORATED
Subsidiary of The Dow Chemical Company
GENERAL OFFICE; TULSA 3, OKLAHOMA
New York • Philadelphia • Baltimore • Buffalo • Cleveland • Chicago
St. Louis • Houston • Kansas City • Wichita • Mt. Pleasant, Michigan
Salem, Illinois
Long Beach, Casper: Dowell Affiliates—International Cementers, Inc.

SPECIALISTS IN CHEMICAL CLEANING SERVICE

Dowell's experienced industrial engineers are backed by the complete research and technical facilities of

Dowell's equipment is modern and complete—scientifically designed. Treating stations and chemical ware-



"tailor-made" to fit each job. All ingredients are of the highest quality, chosen

DOWELL

FOR INDUSTRIAL CHEMICAL SERVICE

SAVE by using B-H MONO-BLOCK

One-block insulation
for ALL temperatures up to 1700° F.

The use of a single material reduces installation time and costs. Mono-Block is strong, yet light and easy to cut, whether in straight lines or in odd shapes. It yields readily to rivet heads or other irregularities of surface. It can be applied easily and quickly.

Mono-Block is not molded; it is *felted* by a patented B-H process. Instead of being a conglomerate of compressed nodules, it is an interwoven structure of long, straight fibres with millions of dead-air cells which are efficient barriers to heat.

These fibres, moreover, are B-H *black* Rockwool, unusually resistant to moisture as well as to heat. This means that Mono-Block is long-lasting—stable even under severe conditions of temperatures and humidity.

* * *

The coupon below will bring you a sample and full information, including the wide range of sizes and thicknesses.

Baldwin-Hill

SPECIALISTS IN THERMAL INSULATION PRODUCTS

Baldwin-Hill Co., 555 Klagg Ave., Trenton 2, N. J.
Send information on products checked below:

☐ Free sample of B-H No. 1 Cement
☐ No. 100 Pipe Covering—effective up to 1200° F. (for long runs overhead, underground, Diesel exhausts)
☐ Mono-Block—the one-block insulation for all temperatures up to 1700° F.
☐ Black Rockwool Blankets (felted between various types of metal fabrics)

NAME _____ POSITION _____
FIRM _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

tween the Bureau of Mines and the University. The Bureau will initiate a research program involving about $100,000 annually. Laboratories will be provided by the University and will be staffed by Bureau personnel. This is part of a large scale development of the five-year synthetic liquid fuels program authorized by the 78th Congress.

Two processes are in general use for converting coal or lignite to liquid fuels, and since both involve the use of gases, the new West Virginia University laboratory is expected to hold a key position in the future development of the Bureau's synthetic liquid fuels research.

Boiler Efficiency with Overfire Air

REPORTS OF TESTS run on a stoker-fired 100 hp HRT boiler at Battelle Institute in Columbus, Ohio, indicate that overfire air used to eliminate smoke showed no change in efficiency even when 22 per cent of the total air for combustion was supplied over the fire by fan jets.

Comparison	Without Jets	With Jets
Burning rate, lb coal/sq ft/hr	16.7	16.7
Air to jets, per cent of total	...	22.0
Average CO_2, per cent	12.1	11.7
Excess air, per cent	44	51
Average flue gas temp., °F	624	586
Average smoke density by Recorder, Ringelmann No.	1.8	0.4
Loss in gaseous combustible, per cent	0.0	0.0
Efficiency, per cent	70.1	70.4

The flue gas temperature remained substantially constant during the tests with the jets, but climbed steadily as the result of accumulation of soot during the operation without the jets.

The tests show that the fan jets can practically eliminate smoke without loss in efficiency.

McCarter Retires from Public Service

AT ITS MEETING in Newark October 16, the Board of Directors of Public Service Corp. of New Jersey, accepted the resignation of Thomas N. McCarter as Chairman of the Board and as a Director of the Corporation and subsidiary companies. Mr. McCarter expressed to the Board his desire to retire on his seventy-eighth birthday, October 20. Thomas Nesbitt McCarter was the prime mover in the formation in 1903 of Public Service Corp. of New Jersey. The consolidation of various public utility companies in New Jersey into one unified system was first proposed by Mr. McCarter; he was instrumental in effecting it and has been in executive charge continuously from the time of its formation.

Mr. McCarter was the first president of Public Service and was re-elected to the presidency of the Corporation and constituent companies each succeeding year up to 1939 when he became Chairman of the

REMOVE DIRT....YES! BUT REMOVE THE WATER TOO!

IT is only doing half a job to remove dirt from turbine oil. If ***full*** protection is to be given a power unit, the oil must be dehydrated as well. For water, more than any other single factor, contributes to the formation of sludge—the real trouble-maker in turbine oil lubrication.

That is why a De Laval Oil Purifier is the most effective turbine oil maintenance unit available. Dirt and water are thrown out of the oil by centrifugal force, the water being continuously discharged, the dirt collecting in the bowl outside of the zone of purification. The efficiency of purification is as high at the ***end*** of a run as at the ***beginning***.

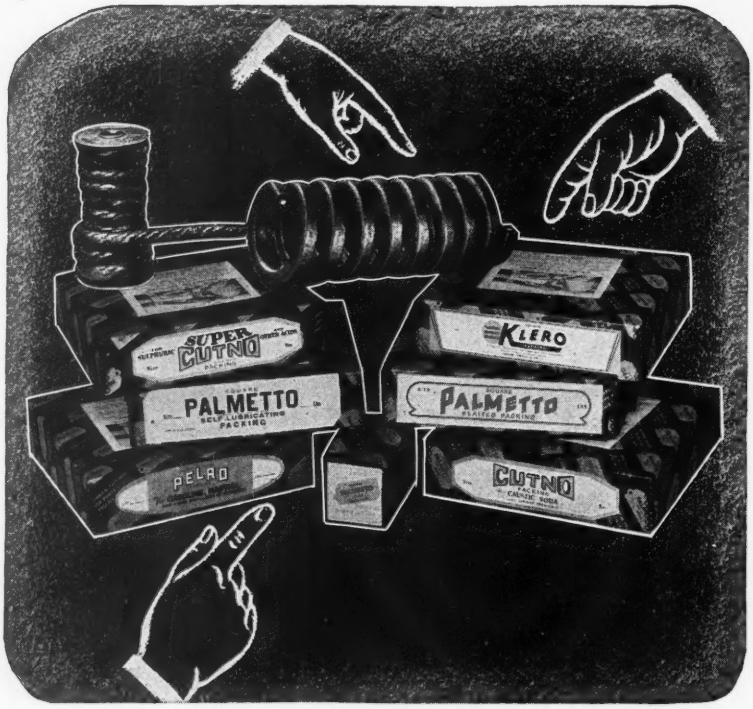
Some power plants call for a single De Laval Oil Purifier, some a complete De Laval-Funk Process, which minimizes the formation of sludge within the turbine lubricating system while it also continuously purifies the oil by means of the De Laval Oil Purifier—the ultimate in turbine oil protection. Whichever ***your*** plant requires, there is a wide range of capacities available to enable the selection of the correct unit.

● Write for Bulletin No. 400.

DE LAVAL

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

LUBRICATING OIL PURIFIERS



PACKING SELECTIONS MADE EASY

You can always put your finger on the RIGHT choice for every service when you standardize on PALMETTO Packings.

That's because the PALMETTO line is SIMPLE, yet COMPLETE.

No complexities, no uncertainty . . . for each grade gives good results in a broad range of applications.

Our handy Packing Application Chart will help you make a selection for trial . . . write for your FREE copy.

PALMETTO
High-Pressure Folded Asbestos Gaskets
Asbestos Metallic Sheet Packing
Asbestos Metallic Gasket Tape
NOW AVAILABLE

GREENE, TWEED & CO.
Bronx Boulevard at 238th Street, New York 66, N. Y.
Plants at New York, N. Y., and North Wales, Pennsylvania

PALMETTO for steam, water, air. PELRO for oils. CUTNO for alkalis. SUPERCUTNO (blue asbestos) for acids. KLERO for foods.
Self-Lubricating **PACKINGS**

Board of Directors at his own request.

Mr. McCarter was born in Newark, October 20, 1867; received his early education at the Newark Academy, and was prepared for college at Doctor Pingry's school in Elizabeth. He was graduated from Princeton in the class of 1888 and later attended Columbia University Law School.

Missouri River Basin Project

INITIAL PHASES of the billion and a half dollar development program for the Missouri River Basin are being pressed forward by the Bureau of Reclamation and other bureaus of the Department of the Interior. Substantial progress has been made in the work of field crews in the basin, this work being centered on completion of engineering and economic surveys on 29 initial projects authorized for construction by the Bureau of Reclamation under a comprehensive development program to harness the Missouri river for irrigation, power generation and flood control.

Plans call for the completion of these surveys on 11 of these projects so that construction can be started in 1946. Four of these projects and funds approved by the House for starting construction are: Angostura Project on the Cheyenne river in southwestern South Dakota, $2,309,600; Roysen dam on the Big Horn river in Wyoming, $1,570,100; Kortes dam on the North Platte river in Wyoming, $1,267,400; and $1,000,000 for construction of a 150-mile transmission line from Williston to Garrison, North Dakota.

The Great Lakes Pipe Line Co. of Kansas City, Mo., has awarded a contract to the Diesel Engine Division of American Locomotive Company for the purchase of 25 Alco Diesel engines.

Bills affecting disposition of industrial wastes are now being considered in the House of Representatives and hearings, starting November 13, are being conducted by the House Rivers and Harbors Committee on these bills which are designated as (HR 419, 587, 4070).

MANUFACTURERS' *News*

Johns-Manville to Expand Plant

AN EXPENDITURE OF $1,000,000 has recently been authorized by Johns-Manville Corp. for the expansion of its plant at Jarratt, Va., which was established in 1938 to meet mounting demand for materials required for housing and industry.

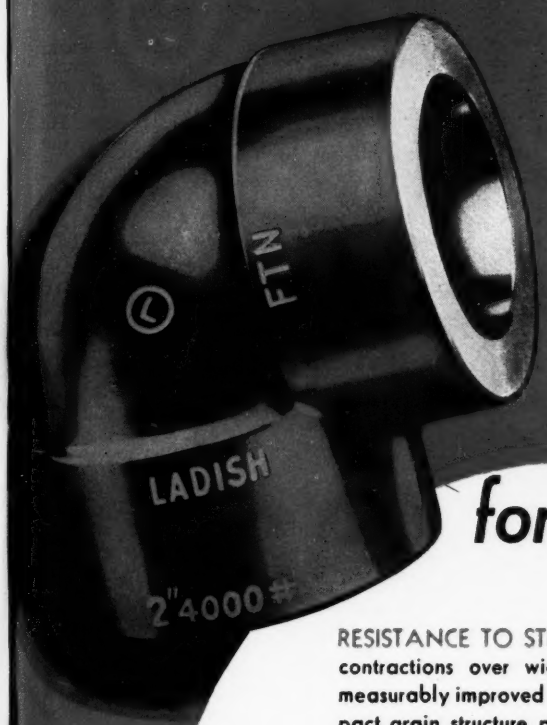
The engineering work is being handled by Stone & Webster Engineering Corp. of Boston, Mass.; and the contract for sub-structural work has

PIPE FITTINGS

Drop Forged

by LADISH

for Greater Dependability



RESISTANCE TO STRAINS of expansion and contractions over wide temperature ranges is measurably improved with the tougher, more compact grain structure provided by Drop Forging.

RESISTANCE TO FATIGUE is accomplished by accurately controlled grain flow for maximum strength at vital points provided by Drop Forging.

RESISTANCE TO SHOCK of hydraulic pressures is materially improved by increased dynamic strength and toughness of metal produced by Drop Forging.

FREEDOM FROM INTERNAL DEFECTS is assured by the denser, more homogeneous metal structure of Drop Forgings.

UNIFORM WELDABILITY
FREEDOM FROM LEAKS
LONGER LIFE

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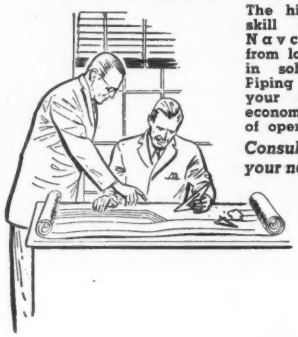
CUDAHY • WISCONSIN (MILWAUKEE SUBURB)

District Offices: NEW YORK • PITTSBURGH • CLEVELAND • ST. LOUIS • HOUSTON • LOS ANGELES

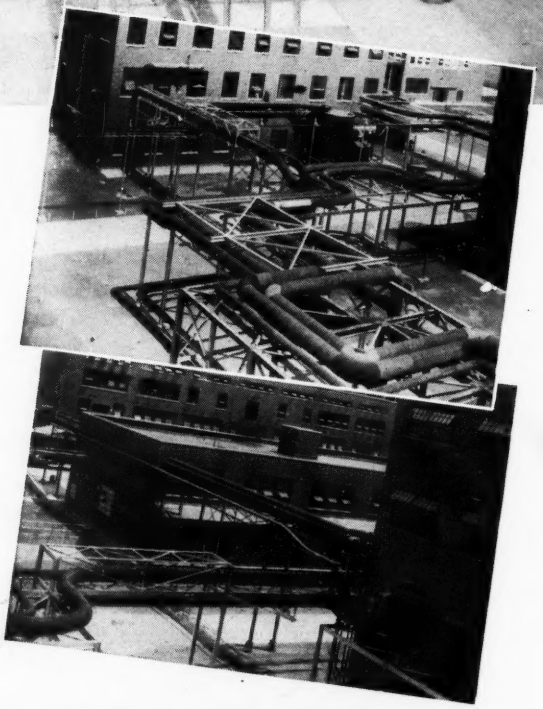
SKILLED ENGINEERING

The difficulties encountered in the fabrication and erection of Central Station and Industrial Piping are many and varied.



The high degree of skill acquired by Navco Engineers from long experience in solving unusual Piping problems is your assurance of economy and safety of operation.

Consult Navco for your next Piping Job.



NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

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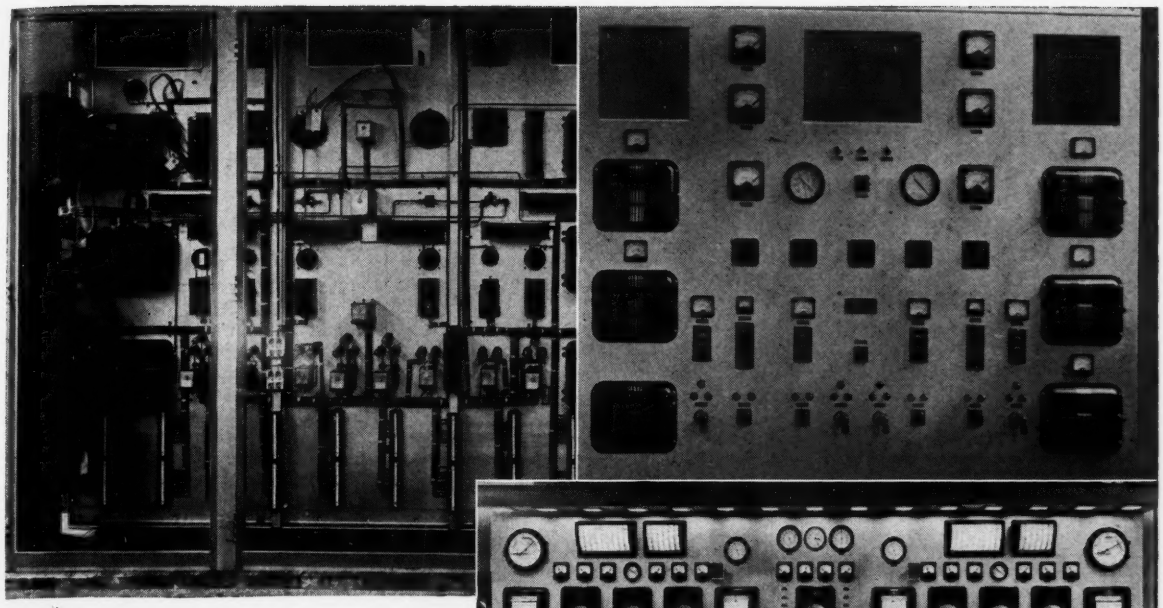


Back and front views, at our plant, of Metermax Combustion Control section of a complete L&N boiler gauge board for Picway Station, Columbus & Southern Ohio Electric Co. Right —two-boiler L&N Control Board installed at Westover Station, New York State Electric & Gas Corp.

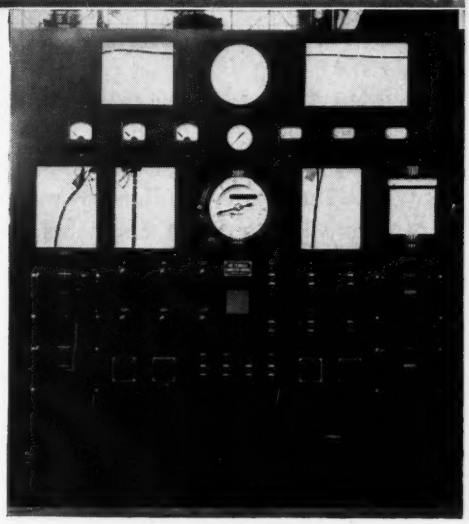
The PLUS VALUES of PANEL ENGINEERING

Give Better Power Plant Control

Panels engineered by L&N have every detail arranged to make the unit as useful as possible to the power plant's personnel. All Controllers and instruments—all gauges, dials and meters—all start-stop stations, switches and signal lights—are in proper sequence for convenient operation. Lighting is bright, level, glareless. Back-of-panel arrangement is exceptionally convenient. Panels show our ten years of experience in supplying *complete* units to meet the problems of power plants.

These Panels arrive with Metermax (or Type P) Combusion Controllers and/or Micromax instruments installed. Major equipment items which we do not make can be supplied or not, but the entire Panel, down to the last wire, is connected and checked. Either with the Panel or ahead of it we send complete structural and wiring blueprints, which greatly reduce the recipient's engineering and drafting work. The Panel as received is ready to install.

Further information will be sent on request.



Labeled in Russian, this is one of eight boiler boards shipped as shown to U.S.S.R. Metermax Controllers and Micromax Instruments are mounted. Wiring for separately-shipped equipment can be seen, cabled and tagged, in cut-outs.

LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

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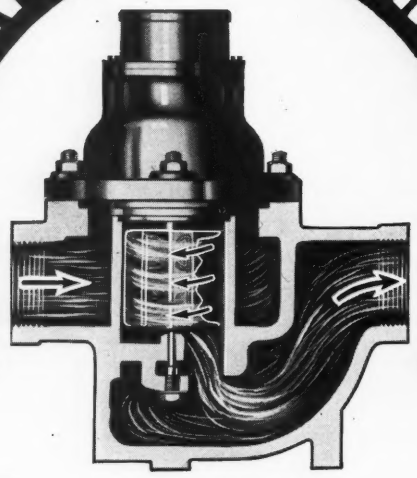
INSIDE STORY



why a

HENSZEY *FEED WATER* METER

can really stand up where others fail

The cutting, abrasive action of hot dirty Boiler Blowdown quickly breaks down meters that depend upon close clearances and intricate parts for their accuracy. And that's why the Henszey meter is the choice of so many Power Plant Engineers for the Boiler Blowdown measuring chore.

Henszey Meters stay accurate — stay on the job — accurately measuring Boiler Blowdown, Feed Water, Condensate, Free-running chemicals and other "hard-to-measure" liquids.

For your tough liquid measuring job where stamina with accuracy is required consider a Henszey Meter.

Send for details.

HENSZEY COMPANY, Dept. C2, Watertown, Wis.

HENSZEY

FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Flow Indicators • Boiler Feed Regulators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

been let to the Consolidated Engineering Co. of Baltimore, Md.

This enlargement of the Jarratt plans is only a part of the $40,000,000 expansion program which Johns-Manville has planned for its plants in the United States, Canada and abroad.

Sylvania Acquires Wabash

PLANS HAVE BEEN made whereby the Wabash Appliance Corp., independent manufacturers of photoflash and incandescent lamps will submerge with the Wabash Photolamp Corp. and Birdseye Electric Corp. to become a wholly-owned but independently operated Sylvania Electric Products, Inc., subsidiary. A. M. Parker will remain as President and General Manager of Wabash with headquarters at Brooklyn, N. Y. Sales staffs, sales policies, product brands and distribution outlets remain unchanged.

The Brooklyn plant will continue manufacture of photolamps, incandescent lamps, reflector lamps and infrared heat lamps, with augmented production of light conditioning and other standard light bulbs. Additional factory units planned for installation at the Brooklyn plant during the next few months will step up photoflash production to more than double that of the highest pre-war year.

New Wabash products slated for immediate devlopment and improvement include new types of photoflash bulbs and other photographic lighting units, ultra-violet and infra-red heat lamps and light conditioning bulbs. Company officials are convinced that the lighting industry is faced with unprecedented opportunities for a vast relighting job that will take many years before a saturation point is reached. New markets created by pent-up needs accumulated during war years, by the vast power projects initiated by the Government and their results in cheaper power and increase in homes wired for electricity mean for light equipment manufacturers a prosperity boom that has never been equalled in the history of our country.

Briggs Clarifier Co. in New Plant

STARTING IN BUSINESS about 10 years ago in an 80 year old livery stable under Key Bridge in Georgetown the Briggs Clarifier Co., manufacturers of specially engineered oil filtration equipment, is now centering all of its offices and laboratories in two modern company secured plants on River Road and the B & O tracks in Bethesda, Md., located on nearly 8 acres of ground fronting on River Road, these new plants cover 167,000 sq ft. Spacious and well lighted, they are equipped with the most modern machinery, some of it designed by Briggs engineers. Tiled locker rooms

Gas Turbines Too . . .

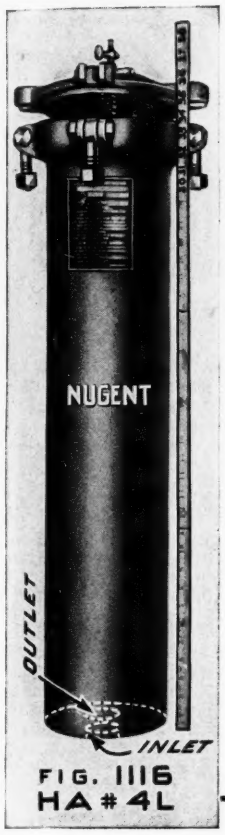
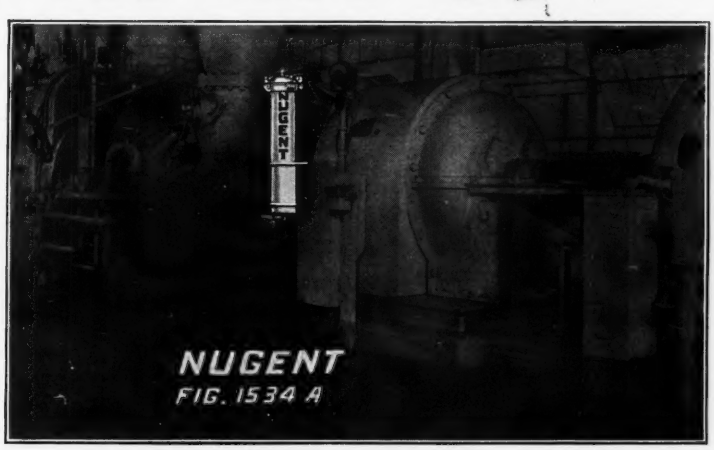


FIG. 1116
HA # 4L



use NUGENT FILTERS

to keep oil cleaner longer — — reduce maintenance — increase efficiency

You can rely on Nugent for efficient oil filters for every industrial application.

Here, a Nugent Filter is installed on a gas turbine at the Sun Oil Refinery, Marcus Hook, Pa. This Brown-Boveri turbine has now been in use for four years, and the Nugent Filter is proving its ability to keep the light turbine oil practically 100% clean.

The filter has a capacity of 30 GPM, yet it is only 38" high by 11½" diameter overall. The efficient filter bag is very inexpensive and is easily replaced when it becomes dirty.

Nugent's long and practical experience in oil filtering is at your service. When you plan new machinery, ask Nugent about the oil filters.

NUGENT
pressure lubricating oil filters

removes all harmful grit, dust, sand, carbon and abrasive. Exclusive Nugent filter cartridge has filtering surface of nearly 3000 square inches. Cartridge is inexpensive, is discarded when dirty. Available in various sizes. Write for Bulletin 7A.

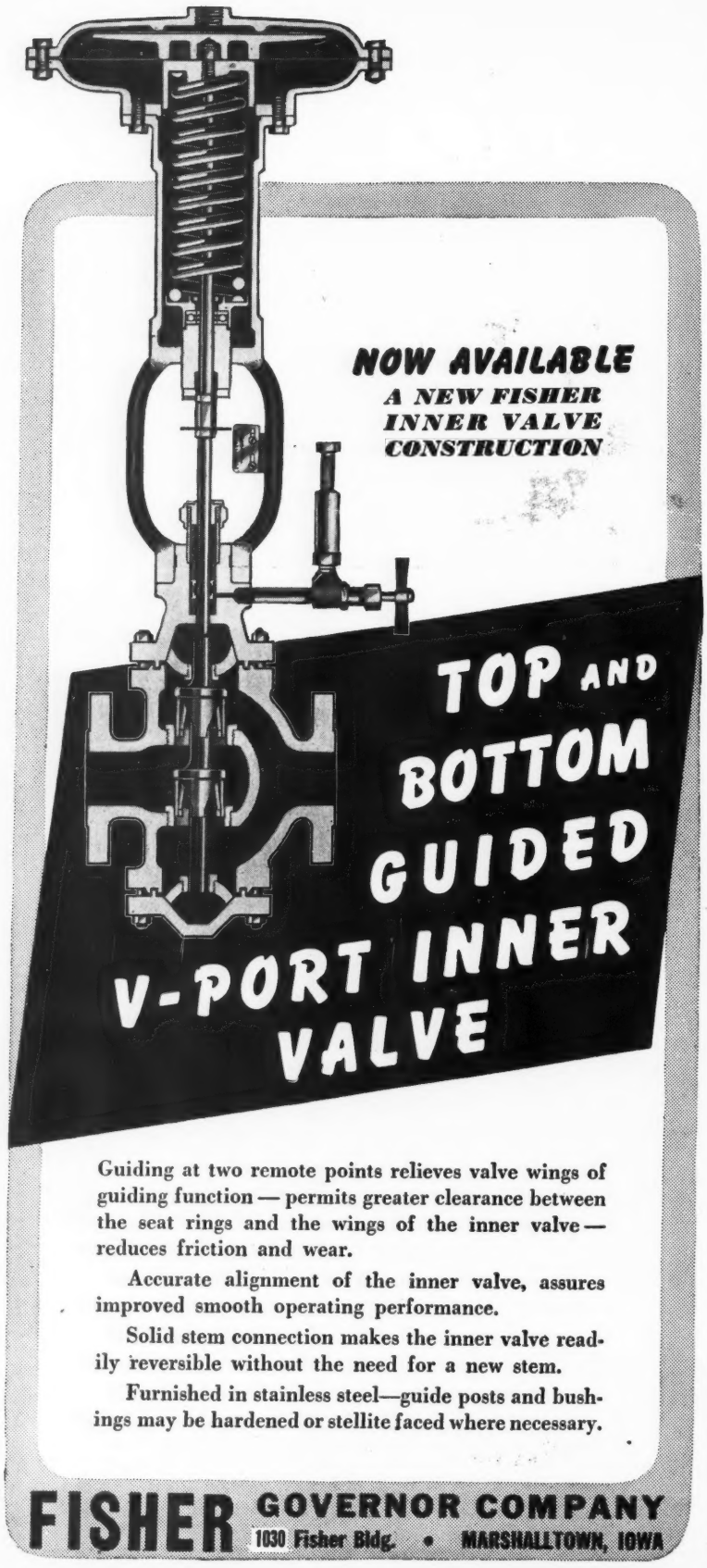
DISTRIBUTORS

Industrial Equipment Co., 6435 Hamilton Ave., Detroit, Mich.
Frank M. Esch Co., 822 M. & M. Bldg., Houston 2, Tex.
H. J. Kelly, 816 Howard Ave., New Orleans, La.
Geo. P. Dempler & Co., 3318 Latonia Ave., Pittsburgh, Pa.
Thos. A. Short Co., 245 Fremont St., San Francisco, Calif.
Dallas S. Deem, 1215 So. St. Louis Ave., Tulsa, Okla.
Harlan G. Bosler, 4452 W. 59th Pl., Los Angeles, Calif.
Darling Bros., Ltd., in all Canada.
Louis H. Hein, Inc., 57 E. Lancaster Ave., Ardmore, Pa.

Nugent Filters
ESTABLISHED 1897

Fuel Oil Filters
Lube Oil Filters
Lubricating Systems
Sight Flow Indicators
Oiling Devices

WM. W. NUGENT & CO., INC.
423 N. HERMITAGE AVENUE CHICAGO 22, ILLINOIS



Guiding at two remote points relieves valve wings of guiding function — permits greater clearance between the seat rings and the wings of the inner valve — reduces friction and wear.

Accurate alignment of the inner valve, assures improved smooth operating performance.

Solid stem connection makes the inner valve readily reversible without the need for a new stem.

Furnished in stainless steel—guide posts and bushings may be hardened or stellite faced where necessary.

FISHER GOVERNOR COMPANY
1030 Fisher Bldg. • MARSHALLTOWN, IOWA

with showers, a non-profit company operated cafeteria, and a company bus operating on a regular schedule between the plants and the Friendship Heights terminus of the Wisconsin Avenue car line contribute to comfortable working conditions.

Concentration of all activities in Bethesda was planned when the company moved the fabrication of filter cases from Georgetown to a rented building on the B & O line in River Road late in 1941. By fall of 1942 Briggs had completed its first plant on ground purchased next to the rented property. At this time all production was moved from the District of Columbia, but Government restrictions on the erection of buildings not used for direct production made it necessary to continue to house offices and laboratories over a wide area of Georgetown.

Hagan Corp. Offers Employees Educational Program

A PLAN TO FILL the current gap in the stream of young chemistry and engineering students, caused by the war, has been started by a Pittsburgh organization. As an investment in the future of their own personnel, Hagan Corp. and its subsidiaries, Hall Laboratories and Calgon, Inc., have announced a plan to back members of their staff in getting college educations in night school which will serve to up-grade them in their work with the three companies.

The companies will pay half the tuition and fees for any course the individual enters, and on attainment of a degree, will pay the other half, according to Dr. Everett P. Partridge, picked by President J. M. Hopwood to supervise the plan.

The idea is a recognition of the fact that many technical staff members already have given years to night school courses to improve themselves at their own expense and that the companies stand to gain from this broadening of horizons through college or university courses in chemistry, engineering or other subjects.

Factory Space Increased by Yeomans Brothers

YEOMANS BROTHERS CO. has recently signed a long-term lease on a two-story building at 937 West North Avenue, Chicago, Ill., which will double its productive capacity. It is reported that after modernization the additional space will house the small pump and sewage treatment sections and the service department. Additional personnel will be required to handle increased production.

Increased demand for pumps of all kinds for industrial and domestic use has been noted with a lifting of material controls and other wartime restrictions. Company officials report that there is a reservoir for 2¼ billions of dollars already approved by states, counties and municipalities for construction of water systems, sewage treatment plants and similar projects which are waiting only for the go-ahead signal.

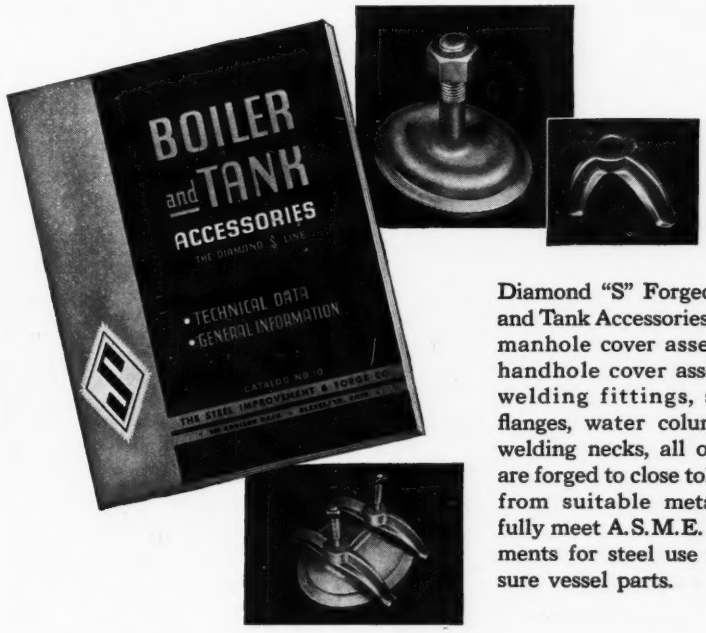
REDUCE UNPREDICTABLE EMERGENCIES

in High Pressure, High Temperature Pipe Lines with...

Gruv-Seal, Forged Iron and Alloy, Ring Gaskets

Pipe line trouble is unpredictable. Meet it before it happens with pressure-proof joints, tight as a weld, made with Gruv-Seal, Forged Iron and Alloy, Ring Gaskets. Wrench pressure molds a tight seal that stays tight, always—reduces power losses and other pipe line trouble. Gruv-Seal, Forged Iron and Alloy, Ring Gaskets are machined to a fine, smooth finish, and fit perfectly. These gaskets should be used at all flange connections, valve bonnet joints, and at joints where ready disassembly is a necessary requirement. They are available in several different grades of metal for different services. Write for Bulletin 45. These gaskets are one item of the complete line of Diamond "S" Forged Boiler and Tank Accessories which includes *manhole cover assemblies, handhole cover assemblies, special welding street ells,* and other similar devices, all of which are forged to close tolerances from suitable metals, and fully meet and exceed A. S. M. E. requirements for steel use in pressure vessel parts.

DIAMOND "S" FORGED BOILER & TANK ACCESSORIES



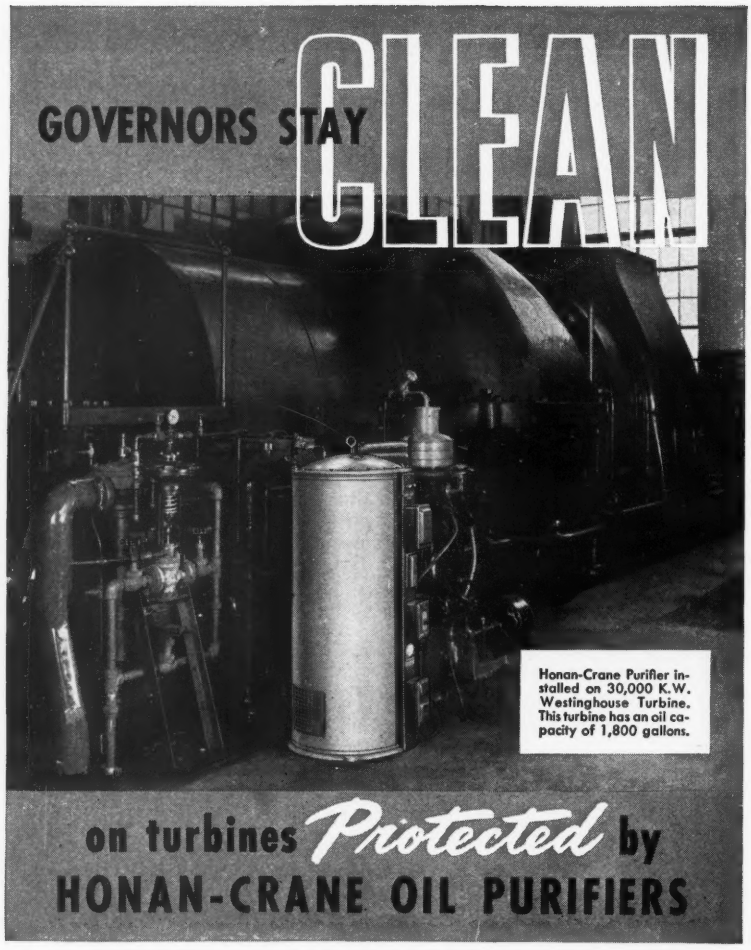
Diamond "S" Forged Boiler and Tank Accessories include manhole cover assemblies, handhole cover assemblies, welding fittings, special flanges, water column ells, welding necks, all of which are forged to close tolerances from suitable metals, and fully meet A.S.M.E. requirements for steel use in pressure vessel parts.

The outstanding advantage available with Diamond "S" Forged Boiler and Tank Accessories is a more generous margin of safety for the protection of both men and equipment in the operation of fired or unfired pressure vessels. Catalog No. 10 illustrates, describes and lists a complete line of forged steel boiler and tank accessories, and contains technical data and general information about the use and application of such products. Write for copy of Catalog No. 10 on your business letterhead.

DROP FORGINGS

THE STEEL IMPROVEMENT & FORGE CO.

966 East 64th Street CLEVELAND, OHIO


GOVERNORS STAY CLEAN
Honan-Crane Purifier installed on 30,000 K.W. Westinghouse Turbine. This turbine has an oil capacity of 1,800 gallons.
on turbines Protected by
HONAN-CRANE OIL PURIFIERS

● Honan-Crane Purifiers, by removing sludge and sludge-forming acids from turbine oils, prevent deposits from forming in governor mechanisms. Keeping governors clean means greater turbine efficiency and less down time for governor repairs and cleaning.

Honan-Crane Purifiers keep turbine oil free from the most microscopic abrasives *and* troublesome acids that cause the oil to sludge and emulsify.

Honan-Crane Corporation, subsidiary of Houdaille-Hershey Corporation, is one of the world's leading manufacturers of oil purification equipment. Backed by extensive engineering and research facilities, Honan-Crane can give you the answer to any problem involving dirty or contaminated turbine or other industrial lubricating oils.

Write for engineering bulletins on the purification of Turbine and other industrial lubricating oils, and complete specifications on Honan-Crane Oil Purifiers.

HONAN-CRANE CORP.
301 INDIANAPOLIS AVE., LEBANON, IND.
Subsidiary of
HOUDAILLE-HERSHEY CORP.

Leslie Co., Lyndhurst, N. J., announces the following appointments of agents to handle industrial sales and service: J. N. Fehlinger, New York City, N. Y., and vicinity; Frank Howell Co., Richmond, Va., State of Virginia; John Zimmerman, Louisville, Ky., State of Kentucky; Bruce Greaves Co., St. Louis, Mo., Eastern Missouri and Southwestern Illinois.

Recent announcement has been made that the Allied Control Co., Inc., of New York City, manufacturers of relays and electronic devices, has acquired the B. F. Miller Co. of Trenton, N. J. The Miller Co. was organized in 1910 and manufactures all types of transformers, particularly those which require special developments or which have unusual applications. It is reported that a policy of research and development would be continued and that the facilities of the company would be enlarged and improved. B. F. Miller remains as Executive Vice-President and General Manager. E. H. Gillette is President of the Allied Control Co., Inc.

New and larger Pacific Coast Region offices of Detrex Corp., Detroit, Mich., have been established at 112 West Ninth Street, Los Angeles 15, Calif. This office, which is under the supervision of S. B. Crooks, functions as sales and service headquarters for the Pacific Coast and Rocky Mountain States.

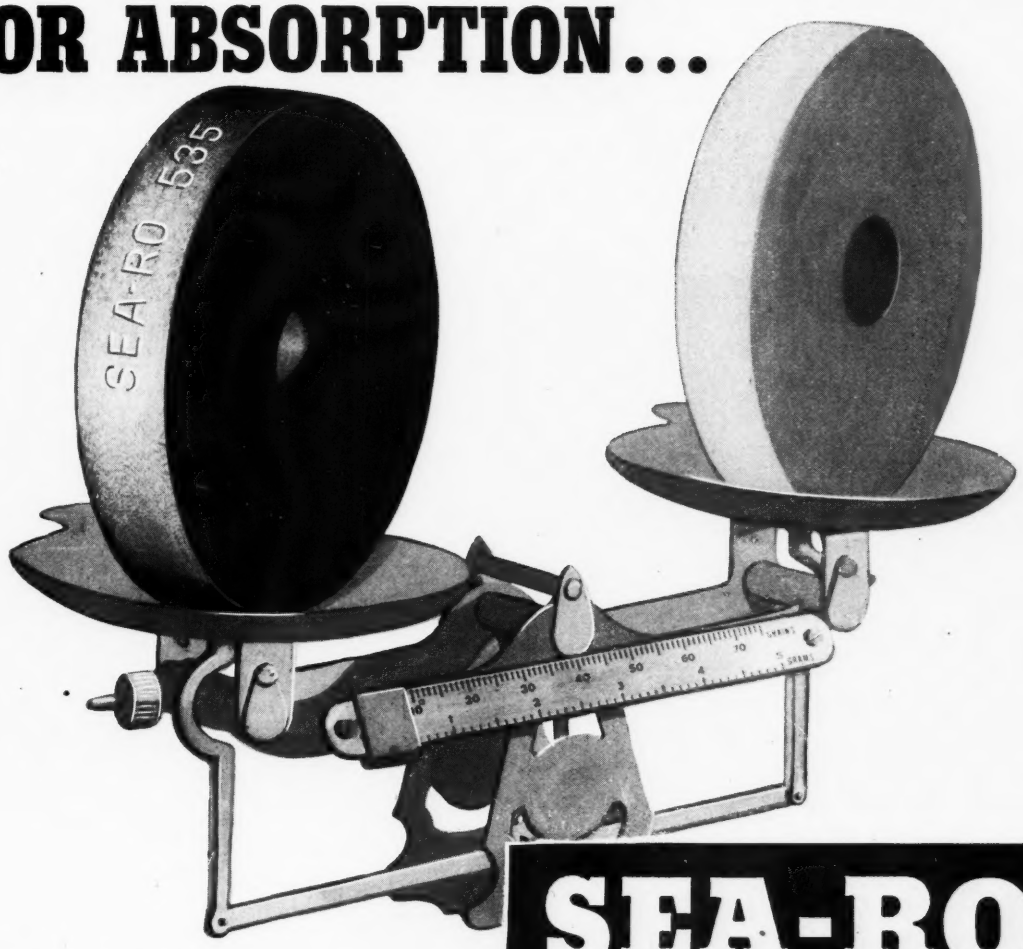
The Southwark Division of the Baldwin Locomotive Works has recently placed field sales engineers in five of the company's branch offices in order to give better and quicker service to the increased number of users of SR-4 strain gages. The men chosen for this service and their officers are: Richard Hannon, Boston; Joseph Farley, Chicago; Robert Cleeland, New York; Glenn Rowell, Philadelphia; and Stanley Zansitis, Detroit. These men can be called upon by any user or prospective user of the gage. Jordan H. Gaul is SR-4 sales manager at the Eddystone, Pa., office.

MANUFACTURERS' *Personals*

C. R. Braun has recently been appointed supervisor of Allis-Chalmers' steam turbine department marine sales, in which position he will be responsible for long range sales coverage of the expanded peacetime production of marine steam turbines.

Appointment of William H. C. Lehman as assistant manager of the apparatus sales of the General Electric Supply Corp., Bridgeport, Conn., has recently been announced. Mr. Lehman has for the past five years been a member of the Apparatus Agency Division of General Electric's Industrial

MAKE THIS TEST FOR ABSORPTION...



An ordinary scale can reveal — in 2 seconds — such a remarkable improvement in pump valves that you will have to make this test for yourself — to realize its significance. Let us send you samples of Sea-Ro 535 valves (see below)*. Balance a valve you now use — with a Sea-Ro of exactly the same weight. Boil them both in water for 24 hours. Then put them back on the scales . . . and watch the Sea-Ro fairly *jump up!*

The absorption-resistance of this dense, fine-grained phenolic-base valve . . . plus its smooth, long-wearing action . . . cuts maintenance cost of any marine pump. Sea-Ro 535s are custom-made — to handle all liquids, temperatures, pumping equipment, normally used on sea-going vessels. They release bronze for war — they last longer — they treat valve seats gently.

SEA-RO MARINE PUMP VALVES

SEA-RO

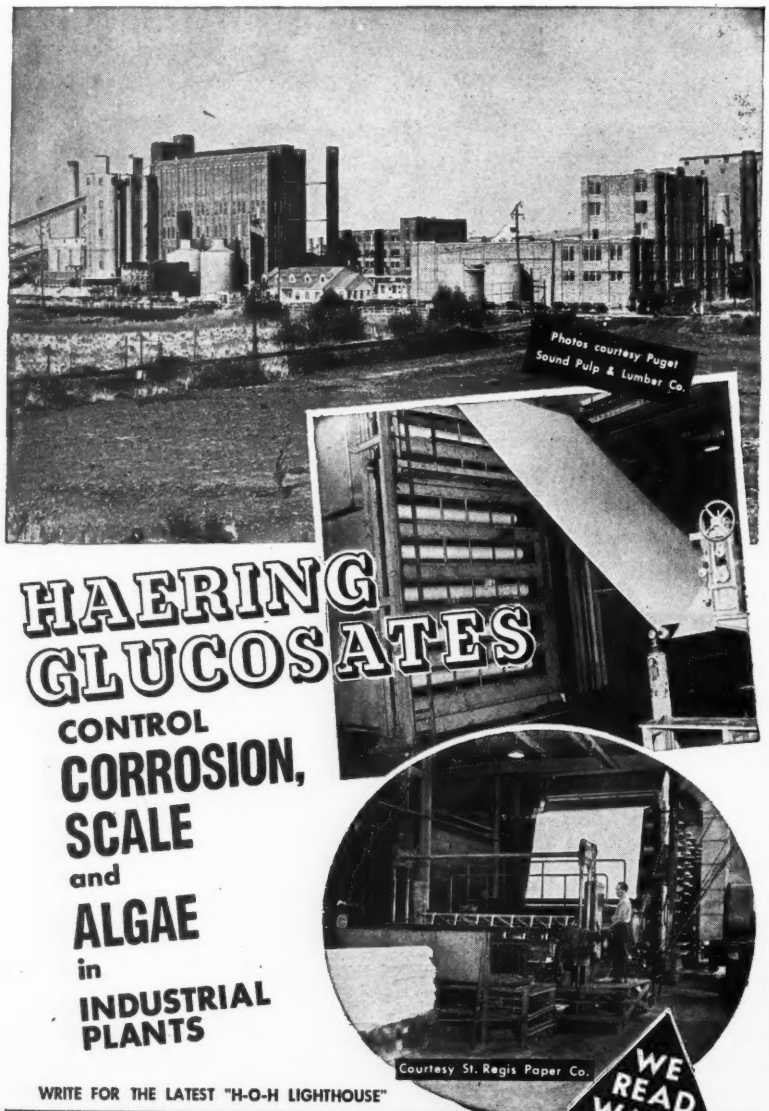
resist absorption

**SAMPLES FREE: You are invited to make this test yourself . . . without incurring any obligation whatever. Simply write today for Free Samples, to: Sea-Ro Packing Co., Wood Ridge, N. J.*

SEA-RO NEK-SEAL PACKING
SEA-RO PUMP PLUNGER RINGS

Divisions. Mr. Lehman was graduated from Nichols Preparatory School of Buffalo, N. Y., in 1927 and received his engineering degree from Union College in 1932. He joined General Electric at Schenectady in 1934 as a business training course student in the accounting department.

Robert G. Allen has recently been appointed by the Baldwin Locomotive Works as general sales manager of the Company, the appointment becoming effective on November 1. Mr. Allen received his education at Phillips Andover Academy and Harvard University. In 1925 he became associated with the Walworth Co., holding the post of Division Sales Manager from 1929 to 1936. He then represented his district in the 28th Pennsylvania District in the Congress of the United States and later was elected president of the Duff-Norton Manufacturing Co., which position he held until July, 1942, when he was granted a leave of absence to accept a commission as Major in the United States Army, Ordnance Department. In the Armed Forces he gained the rank of Lieutenant Colonel and served overseas as Battalion Commander and Group Commander. He joined the Baldwin organization as general manager of Baldwin Southwark Division of the company in 1945.



Announcement is made by Allis-Chalmers Mfg. Co. that Dr. J. T. Rettaliata, whose work on steam and gas turbines with the company has become nationally known, will continue his association as consultant on gas turbine development and similar problems, in addition to his work as director of the mechanical engineering department at the Illinois Institute of Technology, which position he accepted last fall. Dr. Rettaliata joined Allis-Chalmers in 1936 after receiving his doctor of engineering degree from Johns Hopkins University. Shortly thereafter, he assumed charge of the calculation and development division of the company's steam turbine department. He has received several recognitions for outstanding engineering achievements and in 1940 he was given a fellowship by the Academy of Sciences, which he used on a year's leave of absence from Allis-Chalmers to write a paper on gas turbines for special applications. In 1943, Rettaliata was sent to England on a special mission involving jet propulsion aircraft and only recently made a trip to Germany to study developments.

Joseph Mangion and Joseph L. Utter have recently joined the staff of Arthur D. Little, Inc., Cambridge, Mass. Mr. Mangion, formerly laboratory director for the Alfred Hale Rubber Co., will take charge of the Arthur D. Little, Inc. rubber laboratory. Mr. Utter will be engaged primarily in work on ceramics. He was previously at the Massachusetts Institute of Technology, where he did war research on precision casting of turine blades and on the atomic bomb.

Ransome Machinery Co., a subsidiary of the Worthington Pump and Machinery Corp., Dunellen, N. J., has recently appointed John P. Favor to General Manager and Consulting Engineer, J. E. Bushnell was promoted to Chief Engineer, George W. Cronk to Chief Draftsman.

Charles T. Evans, Jr., has been appointed as chief metallurgist for the Elliott Co., Jeannette, Pa. Formerly manager of the carbide department of the Titusville plant of the Universal-Cyclops Steel Corp., Mr. Evans has been concerned with the development of high temperature resistant steels for application to high-temperature steam and refinery valves, turbocharges, jet and rocket propulsion equipment. In his new assignment he will be responsible for the metallurgical problems of the whole Elliott Co., with particular attention to metallurgical aspects of research and production of gas turbines.

Paul W. Eberhardt has been elected to the office of a vice-president of the Walter Kidde & Co., Inc., and his principal duties will include management of domestic sales of the company's fire-fighting equipment in aviation and general industry, together with general supervision of field selling activities.

Tube Turns, Inc., Louisville, Ky., has appointed Fred C. Smith as Director of Quality. Mr. Smith acquired his B.S. and Ch.E. degrees at Purdue and began his administrative career as plant metallurgist with International Harvester in Fort Wayne and Chicago. Prior to joining Tube Turns

Important News

. . . to all users of protective coatings

The Dampney Company of America **announces its acquisition of** ***The Thurmalox Company,*** **makers of a famous line of specialized protective coatings. Outstanding among these are THUR-MA-LOX coatings, in which heat resistance has been developed to extreme limits. In particular:**

THUR-MA-LOX NUMBER 7 BLACK — For exterior and interior metal surfaces at temperatures up to 1600°F.

THUR-MA-LOX NUMBER 10 ALUMINUM—For interior metal surfaces at temperatures to 1200°F.

Equally well known products of the Thurmalox Company are THURCO coatings, in a variety of types for widely differing applications.

These quality products now join Dampney's long-established leaders:

APEXIOR NUMBER 1 — For "hot-wet" metal surfaces.

APEXIOR NUMBER 3 — For "cold-wet" metal surfaces.

Together, APEXIOR, THUR-MA-LOX, and THURCO comprise a line of specialized coatings of broad range and dependable protection.

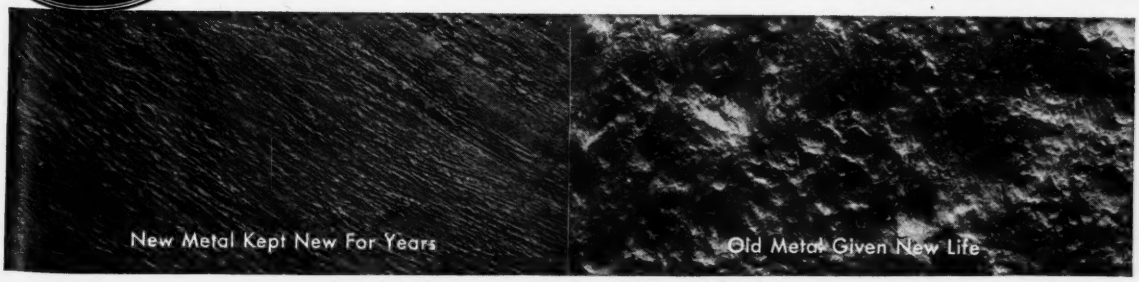
With greatly expanded scope and manufacturing facilities, The Dampney Company looks forward to increased opportunities for service in a wider field.

The Dampney Company of America, Hyde Park, Boston 36, Massachusetts.

APEXIOR

Keeps new metal new . . . Gives old metal new life

DAMPNEY



in January, 1943, as chief metallurgist, he was field metallurgist for Carnegie-Illinois.

The Briggs Clarifier Co., Washington, D. C., has announced the appointment of Curtis Engine and Equipment Co., 104 Light Street, Baltimore, Md., as marine products distributor for the Chesapeake Bay area, which includes all Maryland counties bordering the Chesapeake Bay.

Appointment has also been made of Weeks Engineering Co., 5426 Olive St., St. Louis, Mo., as industrial products distributor. The territory assigned includes Eastern Missouri, a part of Southern Illinois and a part of Southern Indiana.

Cutler-Hammer Inc., Milwaukee, Wis., announce the appointment of E. U. Lassen as Assistant Chief Engineer. Mr. Lassen, a native or Norway, obtained his technical education at the Federal Institute of Technology, Zurich, Switzerland, receiving the degree of Electrical Engineer in 1923. The following year he came to the United States and joined the Cutler-Hammer organization as a draftsman. Later in 1924 Mr. Lassen transferred to the Company's Engineering Department as a designing engineer.

Fisher Governor Co., Marshalltown, Iowa, has appointed the Puffer-Sweiven Co. as its representative in the Texas Gulf Coast area. The office address is—Room 605, Merchants & Manufacturers Building, Houston 2, Texas.

Westinghouse Electric Supply Co. has announced the appointment of Robert A. Bozeman as district stores manager with headquarters in Atlanta, Ga. Mr. Bozeman, who succeeds B. C. Luttrell, resigned, has seen 20 years of service with Westinghouse during which time he has been employed as sales clerk, assistant purchasing agent and office manager.

Swartwout Co., Cleveland, O., has established a new Chicago office to serve steam power plant equipment customers. H. P. DeHart, with the engineering department at Cleveland for nine years, is in charge of this office at 120 South LaSalle Street.

Stanley Engineering Co. of Muscatine, Iowa, has announced that Frank W. Martin has joined the organization as Mechanical Engineer. Mr. Martin brings with him a wide experience in the operation and design of steam power plants and municipal electric systems.

George O. Boomer was elected president of Tube Turns, Inc., Louisville, Ky., at a recent meeting of the board of directors. He was vice president of Tube Turns when Walter H. Girdler, Sr., founder of the company, died suddenly last January. Mr. Boomer succeeds Rudy E. Fritsch, who resigned early in October. Mr. Fritsch will remain with Tube Turns as a consultant for the present.

John R. Armstrong has rejoined Russell T. Gray, Inc., after serving as a captain in the training literature and visual aids section of the Coast Artillery Corps at Fort Monroe, Virginia. Mr. Armstrong as vice-president in the advertising agency, will resume specialization in the industrial field.

Allis-Chalmers Mfg. Co. of Milwaukee, Wis., has announced the following changes in personnel: J. K. Keogh has been appointed manager of the Pittsburgh district office. J. L. Singleton becomes manager of the 60 district offices of the company's general machinery division's sales department. William H. Knight has resigned as manager of the company's Duluth, Minn., branch sales office and will be succeeded by John G. Barta of the Milwaukee district office. Ralph A. Powers has been named engineer-in-charge-of electronic engineering for the company.

Link-Belt Co. announces Joseph W. Sears has been appointed district sales manager with headquarters at 711 Main St., Houston, Texas, and Stuart Penick as district sales engineer at Dallas, to fill the vacancy created by Mr. Sears' transfer to Houston.

Economy Pumps, Inc., Hamilton, Ohio, announces the appointment of E. E. Baker as manager of Distributor Sales Division. Mr. Baker will make his headquarters at Hamilton

GIVE YOUR BOILER WATER A CHANCE

TO DO AN *Efficient Job!*

Proper chlorination of cooling water in your condensors will forever control slime and other enemies of efficient heat transfer. Now, with the Taylor-Enslow Slide Chlorimeter, you may make a periodic ***two-minute test*** and be certain of the proper residual concentration of chlorine at all times. It's easy, accurate and fast, will save you its cost many times over.

With a Taylor-Betz Nitrate Comparator, you may quickly determine the nitrate concentration and minimize caustic embrittlement.

All Taylor Color Standards carry **AN UNLIMITED GUARANTEE AGAINST FADING . . .** assure lifetime accuracy.

TAYLOR-ENSLOW SLIDE CHLORIMETER, 0.0-1.0 ..... $18.50
TAYLOR-ENSLOW SLIDE CHLORIMETER, 0.0-3.0 ..... $18.50
In wooden carrying case $23.50
TAYLOR-BETZ NITRATE SLIDE COMPARATOR $18.00
In wooden carrying case $25.00

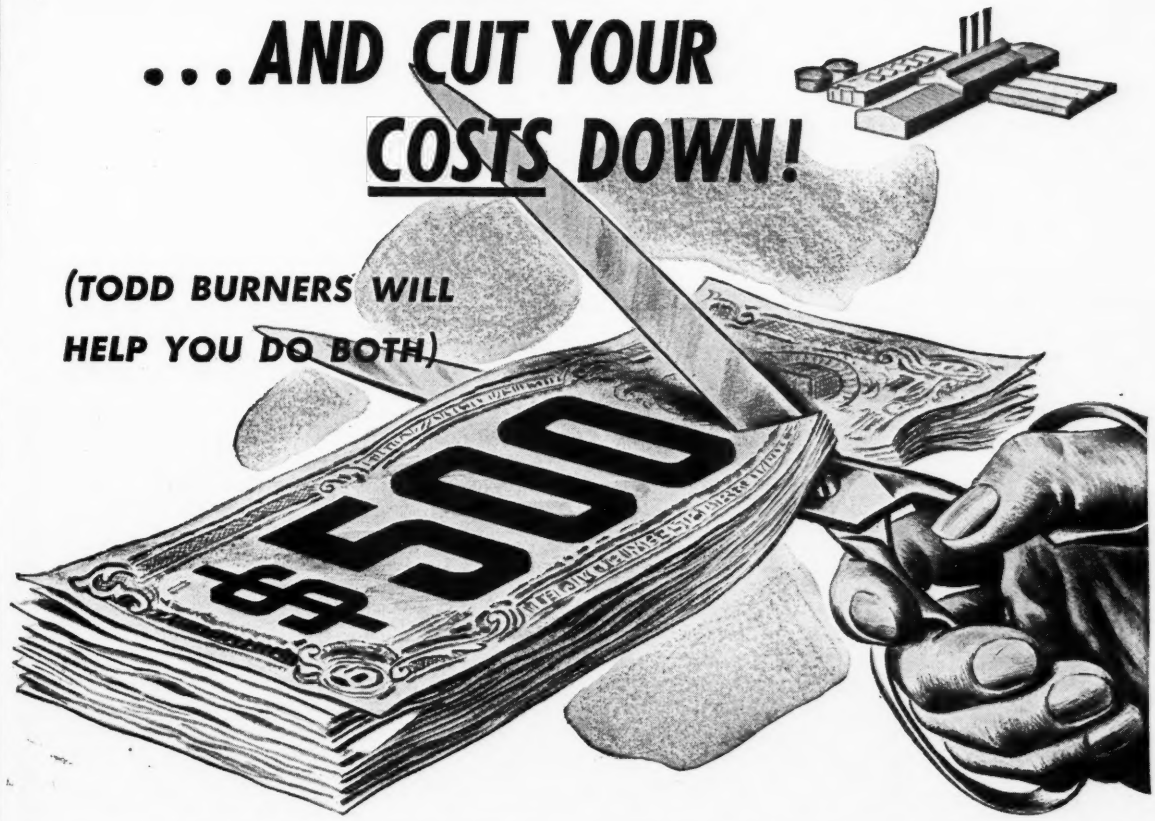
WRITE TODAY for new, authoritative booklet, "pH and Chlorine Control," or see your dealer direct.

W. A. TAYLOR AND CO.
7301 YORK RD. • BALTIMORE-4, MD.

GET YOUR STEAM UP

...AND CUT YOUR COSTS DOWN!

(TODD BURNERS WILL HELP YOU DO BOTH)



POWER will be needed—and how—for industry's great program of post-war production! But, more than ever, power engineers must watch cost figures...figure out new economies.

Consider seriously therefore the question of *modernizing* your boiler room through the installation of Todd Oil or Gas Burners.

Savings up to 10%, on the one hand...increased power on the other . . . for Todd Burners' instantaneous response to fluctuating demands produces *more* steam on *less* fuel consumption!

You pay less for maintenance with Todd, too, because Todd Burners can be operated automatically to meet changing load conditions.

Whether you are producing power and heat for industrial, commercial, or marine purposes, investigate the efficiencies and economies of automatic Todd Combustion Equipment.

Todd specialists, like the deeply-experienced Todd organization itself, are ready to solve your liquid and gaseous combustion problems.

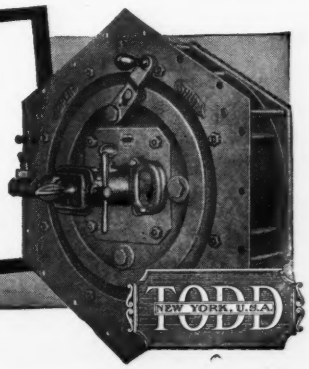
ARMY E NAVY

COMBUSTION EQUIPMENT DIVISION

TODD SHIPYARDS CORPORATION

601 West 26th Street, New York 1, N. Y.

NEW YORK, BROOKLYN, ROCHESTER, HOBOKEN, NEWARK, PHILADELPHIA, CHICAGO, SO. PORTLAND, ME., BOSTON, SPRINGFIELD, MASS., BALTIMORE, WASHINGTON, DETROIT, GRAND RAPIDS, TAMPA, GALVESTON, HOUSTON, MOBILE, NEW ORLEANS, LOS ANGELES, SAN FRANCISCO, SEATTLE, TACOMA, MONTREAL, TORONTO, BUENOS AIRES, LONDON



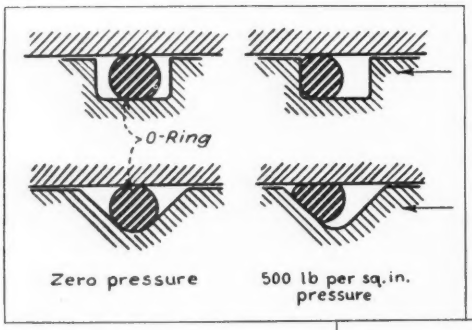
but will be traveling and meeting his old friends in the trade the greater part of the time. He has already appointed the Aetna Engineering Co. with offices in Ashaway, Rhode Island, Hanover, Mass., and Boston, Mass., as distributors for Economy Pumps throughout New England.

Commander George Gellhorn, who left Worthington Pump and Machinery Corp. on January 1, 1942, for active duty in the U. S. Navy, has been released to inactive status and has returned to resume his position as export manager with offices at Worthington's Harrison Works.

G. S. Myers has been appointed a member of the chemical engineering staff of Eshelman & Potter, combustion and chemical engineers, of Birmingham and Charlotte, N. C. Mr. Myers' work will involve both Hagan combustion control and Hall Laboratories water conditioning in southern areas, including the marine field.

Palen Flagler has been appointed Director of Advertising and Publicity for the De Laval Steam Turbine Co. Mr. Flagler, recently with the Bendix Aviation Corp., Philadelphia Division, will make his headquarters in Trenton, N. J.

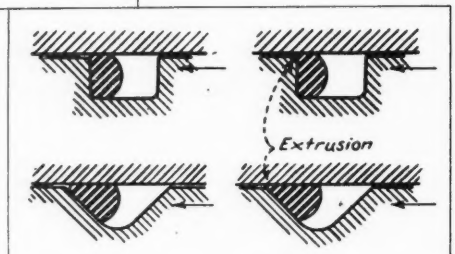
"O" Rings Will Do Things That Other Packings Won't!



"O" Ring Packing is becoming more and more popular in the industrial field because of its low cost and reliable performance under extreme conditions.

If you are in the process of new design, please request information on "O" Ring Packing from our engineering department.

"O" Ring Packing is round in cross-section. It operates efficiently at temperatures from zero to 300° F., in air cylinders and hydraulic oil and water cylinders up to 1000 lbs. per square inch. It forms a perfect static seal up to 3000 lbs. per square inch.



GOODALL "O" Ring Packing is manufactured under careful supervision to close tolerances. Basic materials are Buna and Neoprene, compounded to exacting specifications covered by Christensen U. S. Patent No. 2,180,795.

Other packings in the GOODALL Quality Line include Pump, Valve Stem, Lip, V-Ring and Sheet types . . . for every industrial service. Remember . . . GOODALL is "Engineered for Your Job."

Contact Our Nearest Branch or Main Office for Details.

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RUBBER COMPANY · INCORPORATED

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WE ARE PARTICIPANTS IN THE OWNERSHIP AND OPERATION OF NATIONAL SYNTHETIC RUBBER CORPORATION

Factory—Trenton, N. J. **Established 1870**

New ENGINEERING BOOKS

Engineering Preview. By Grinter, Holmes, Spencer, Oldenburger, Harris, Kloeffler and Faires. Copyright 1945; illustrated; 6 by 9½ in., 581 pages; cloth cover; published by The Macmillan Company, 60 Fifth Avenue, New York, N. Y.; price $4.50.

For a great many years, young men contemplating engineering as a career, laymen who want to get some idea of what the engineer does and the sort of things he must know, have not had a very satisfactory way of finding out those things. The reason is that most of the material, both spoken and written, intended for laymen and attempting to explain engineering to them, have talked *about* engineering. This has never been satisfactory because the only way in which a non-engineer can gain an adequate conception of engineering is by studying engineering itself, not by reading discussion about it.

This book Engineering Preview is based on that idea, hence is a most unusual book. It would prove of the highest value to a high school student debating whether or not to go into engineering. At this writing, it should prove equally helpful to veterans coming out of the service who may want to consider going into engineering even though they have never done so before. To the layman it will give some idea of what the engineer has to know in order to accomplish some of the miracles of engineering he has wrought for the laymen during this war and, of course, for a great many years before that. Finally, the book has still another value for another class of reader; namely, the reader who has covered considerable ground in mathematics, physics, light and electricity, thermodynamics and the like. He could use this book effectively as a rapid review of the high spots. The equivalent material could not be found elsewhere in less than a half dozen volumes.

To accomplish the purpose in view, the book, as stated above, shows the reader what engineering is by presenting the actual engineering subjects themselves just as they must be studied by the engineer, in condensed and well-illustrated form, but nevertheless with no intent to popularize.

An effective way to learn whether or not you really should become a scientist or engineer is to read and to work simple problems in those fields. If you find the present book timesome and confusing, it is unlikely that you would want to become a technologist and it is extremely probable that you do not have the mental bent or aptitude for it. But if it seems clear and stimulating, you are probably destined to use a slide rule. If you are already working in a factory which has a power plant and you want to get some idea of the reason why the very abstruse subject of thermodynamics has to be used in designing that plant, and why its operation depends on thermodynamic principles, there is only one way for you

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" — *Headquarters for BRASS, BRONZE, and COPPER*

Power Plant Operating Data Helps Increase Condenser Tube Life

Valuable Aid in Selecting Longer Lasting Alloys

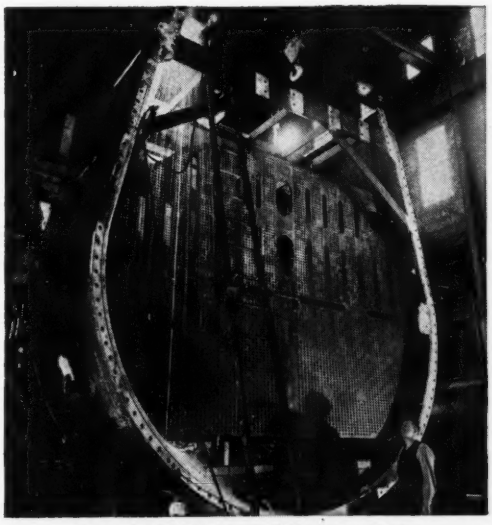
Use of the condenser tube alloy most suitable for the conditions involved is one of the important factors in obtaining greater operating efficiency, reduced maintenance, and higher condenser vacuum. The nature of the cooling water, power plant operating conditions and the severity of operating schedule all involve factors which have an important bearing on the selection of condenser tubing. Provision must also be made for additional future capacity and for the possibility of conditions becoming more severe.

Many years ago selection of tubing was hampered by the limited number of condenser tube alloys available and by the fact that there was much less information on corrosion and condenser tube performance than is now available. Fortunately the picture has changed and condenser tube manufacturers, using powerful extrusion presses and tube reducing equipment, are able to produce a wide variety of condenser tube alloys capable of longer service life under more severe conditions. Metallurgical progress and corrosion research have played an important part in this, and Bridgeport Brass Company has maintained a particularly active corrosion program consisting not only of laboratory work and field tests, but also of actual service tests carried out in collaboration with power plant engineers. We have supplied many samples of tubing to be inserted in condensers or heat exchanger units for test purposes. These are removed from time to time and examined by the laboratory. The results are correlated with information already available and a report is submitted to the power plant and to their consultants.

A New York Harbor Experience

Sometimes the service life of an alloy tested will be so much greater than the material previously tried that a change is unmistakably indicated. For example, a power plant located in New York harbor had been using Admiralty, which lasted a maximum of two years. They then tried out aluminum brass without a dezincification inhibitor. These tubes also failed from dezincification within two years. In 1941 this condenser was retubed with over 6000 tubes of Bridgeport's Cuzinal (arsenical aluminum brass). This alloy was developed to withstand the action of sea water moving at a high velocity which leads to so-called impingement corrosion, or inlet end corrosion.

For the balance of 1941 this condenser operated for 4000 hours; in 1942 for 6300 hours; in 1943 for 8000 hours; in 1944 for more than 8000 hours; in 1945 for more than 8000 hours—more than 34,000 hours without let-up. It is still operating under heavy schedule, and during the entire period only 56 tubes have failed. These were plugged, and have not yet been removed from the condenser. Since this represents a failure of only eight tenths of one percent under exceptionally severe wartime operating conditions, it is evident that Cuzinal (arsenical aluminum brass) is superior for these operating conditions to Admiralty or aluminum brass containing no dezincification inhibitor.



Section of Allis-Chalmers 35000 sq. ft. welded steel surface condenser.

Duronze IV Also Tried

An interesting feature of this experience is the fact that at the time the condenser was retubed with Cuzinal, a test installation of Duronze IV had already been in operation in the same condenser since 1938.

Duronze IV is an arsenical aluminum bronze considered to be one of the finest condenser tube alloys made. It has exceptional resistance to corrosion under severe conditions, such as rapidly flowing fresh or salt water polluted by sewage and industrial wastes, acids, cinders and other foreign matter.

The test installation of Duronze IV was left in the condenser when it was retubed in 1941. Now, all but one of the Duronze IV tubes are still going strong after 63,400 operating hours over a period of 92 months—practically full time operation. Here the possibilities of Duronze IV are again emphasized for increasing condenser tube life under difficult service conditions.

Data From Power Plants Important

When more operating information is available the power plant engineer is in a better position to know which type of condenser tubing will give him the longest service life. Some engineers are keeping careful records regarding the factors listed below, which represent the type of information most helpful to him.

1. Water composition.
2. Steam composition.
3. Velocity of water.
4. Velocity of steam.
5. Operating procedures.
   a. Temperature of water and steam.
   b. Pressures—vacuum.
   c. Service hours.
   d. Amount of debris collected in water boxes.
   e. Frequency of cleaning.
   f. Frequency and dosage of chlorination.
   g. Frequency of tube cleaning.

Many Bridgeport Alloys Available

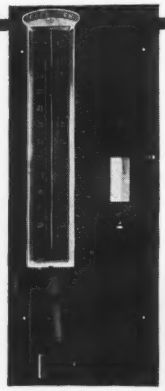
There are a number of Bridgeport condenser tube alloys giving good account of themselves in power plants all over the country and on board ships sailing the seven seas. They are not only used for condensers, but for many heat exchanger applications. Our Technical Service Department, composed of laboratory trained men, is set up to help engineers solve their corrosion problems, and arrange for test lots of tubing to be installed. Contact the nearest Bridgeport office. Also write for your copy of Bridgeport's 112-page Condenser Tube Manual, which contains practical, up-to-date information about corrosion research, condenser tube alloys, methods of installing and suggestions for increasing tube life.

"Bridgeport" **BRIDGEPORT BRASS**

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

PRINCO

ABSOLUTE PRESSURE GAUGES



IDEALLY SUITED FOR EQUIPMENT OPERATING AT A MINUS PRESSURE

FOR ASSURED ACCURACY

PRINCO'S PERFECTED DESIGN

Avoids Mercury Column Contamination — Dual profection of a condensation trap and special reservoir construction keeps mercury column free from dirt, air, moisture or other contaminating elements.

Prevents Air Entrapment — No inaccuracies from air bubbles in the gauge tube. PRINCO design keeps air ***out,*** mercury in.

Eliminates Barometric Pressure Corrections — PRINCO Absolute Pressure Gauge is direct reading. After initial calibration at the factory no further compensation for atmospheric pressure is necessary.

PRINCO'S INDIVIDUALLY CALIBRATED SCALES

Assure maximum accuracy. Every scale is individually calibrated by a skilled instrument maker by comparison with a specially designed high precision standard gauge. The Scale of the PRINCO Absolute Pressure Gauge covers a range of 18" to 30" of vacuum in terms of mercury column, or inversely, 0" to 12" of absolute pressure (in terms of mercury), or 0 to 6 p.s.i. absolute pressure. Gauges can be supplied with a combination of any two scales of the three.

PRINCO Absolute Pressure Gauges are ideally adapted for almost any equipment operating at a minus pressure, such as turbine condensers or exhaust hoods and other condensing and evacuating equipment.

Send complete specifications with your order, or write for Bulletin "D" for prices and additional information.

PRECISION THERMOMETER COMPANY

PRINCO

PRECISION INSTRUMENTS FOR INDUSTRY

1421 Brandywine Street, Philadelphia 30, Pa.

to find out and that is to study a little thermodynamics in the section of the book devoted to that subject.

You may not like it, but that makes no difference provided it helps you understand what the engineers have to know in order to build and operate plants like this.

In any case, says the book, wherever the engineer, you may be sure that responsibility follows him. And because of his willingness to accept responsibility and his ability to produce under difficult conditions, the engineer soon finds himself in an administrative position. After 20 years of practice more than one-half of all engineers have become administrators. It is literally true that in order to remain an engineer, the engineer must often refuse advancement in salary and position. Strange as it may seem, some do.

Those are the concluding sentences of the first section of the book devoted to a discussion of science and engineering. The authors first discuss the relation of science and applied science, which is engineering, to culture. Then they take up the difference between a scientist, an engineer and a technician. A very effective self-administered test is included by which you can tell whether or not you have the apptitudes required for success in any one of these fields. This is followed by a discussion of the good and bad techniques in engineering; how the engineer uses mathematics; why physics, next to mathematics is the second great tool of the engineer, a point that deserves much more emphasis than it has apparently received in engineering; the scope of chemical engineering, civil engineering, mechanical, and other branches; technology and government are discussed and the section concludes by discussing how to become an engineer.

Those are the first 52 pages of the book. The remainder of the 580 pages is devoted to chemistry, technical drawing, mathematics, the slide rule, light and electricity, mechanics, thermodynamics, and at the end of the book are given tables for calculations including five place logarithms, trigonometric functions and the like.

These various sections, as we said before, do not talk about these subjects, but are the subjects themselves. For example, in the chemistry section, when you get to radio-activity you will find a very good diagram and explanation of the cyclotron for producing artificial radio-activity. This section gives the actual principles and reactions of chemistry itself and is strictly up-to-date.

The technical drawing section gives you instructions on exactly how to do modern technical drawings with many illustrative examples.

In the mathematics section, you begin with a discussion of what numbers are, then explanations of arithmetic, elementary algebra, trigonometry, conic sections and the equations of various lines and curves. Light and electricity and mechanics are treated in much the same way. The section on thermodynamics is one of the best analyses we have seen, bringing together the theoretical conceptions of the science and their practical application in everyday machinery such as power plants, refrigerators and automobile engines.

REMOVES SOOT & FIRE-SCALE WHILE BOILERS OPERATE

CHIPPING AND SCRAPING IS UNNECESSARY when you use XZIT. Simply feed XZIT into the firebox while the boilers operate. When thrown on the fire in a furnace it forms a gas which permeates all parts of the boiler, the uptakes, and the stack and has a chemical reaction on the soot and fire scale.

XZIT can be used to extinguish stack fires and to stop sparking. Regular use keeps boilers and stacks clean and free of soot and fire-scale.

Used by all types of merchant and naval ships, XZIT is a proved product. Write for demonstration or order a trial supply. There is an XZIT representative near you.

XZIT FIRE SCALE & SOOT ERADICATOR

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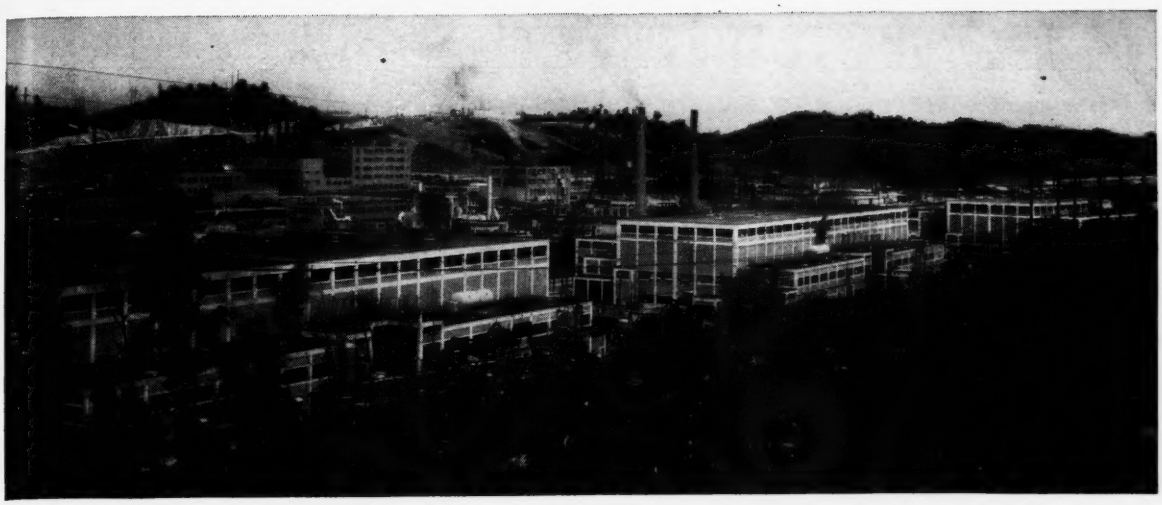

ELECTROMAGNETIC

Stone & Webster Engineering Corporation recommended the electromagnetic process among several possibilities as the quickest way to mass produce U-235—the essential element in the Atomic Bomb.

How successful this process was is indicated in the Smyth Report.

We quote:

"Construction of the first series of electromagnetic units at Clinton began in March of 1943 and this part of the plant was ready for operation in November 1943."

8 MONTHS TO FIRST OPERATION

"For nearly a year the electromagnetic plant was the only one in operation."

A YEAR AHEAD IN PRODUCTION

"The electromagnetic separation plant was in large-scale operation during the winter of 1944-1945 and produced U-235 of sufficient purity for use in atomic bombs."

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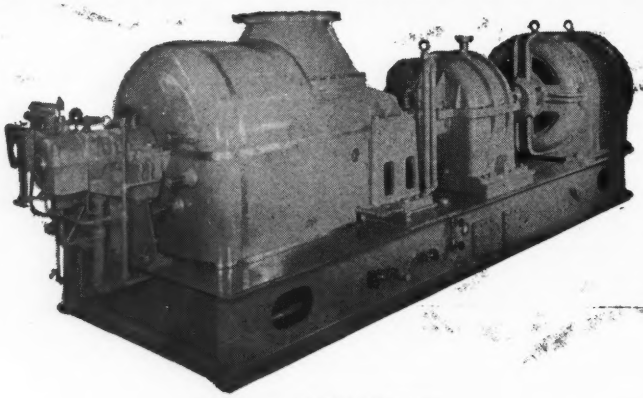
MURRAY
TURBINE GENERATORS



500 KW—PACKAGE TYPE

The unit shown above was designed to deliver 500 KW 50 cycle alternating current on steam at 285# gauge, 700 degrees F., and exhausting condensing to 27 inches vacuum. Thirty identical units were furnished.

Equipment included trip and throttle valve, oil relay governor controlling single throttling inlet valve with hand valve control for partial load operation, all service connections above floor line except generator leads, drain piping brought to one point, and structural steel baseplate. The baseplate is sufficiently rigid so that the unit can be handled in one piece, and installed on the simplest of foundations.

While "Package Type" units are furnished for export for installation in remote areas not previously supplied with power, similar designs can be made for industrial plants for main or standby power supply.

MURRAY *also produces:*

Mechanical drive turbines, horizontal and vertical Reduction Gears — Steam Boilers

MURRAY IRON WORKS COMPANY

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BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

Boiler Repairs Reduced 75%

writes user of **NATIONAL GIRTH SEAM PROTECTOR**

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.

Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

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to assume executive responsibilities for proposals, contracts and design, in cooperation with our Engineering Department, of bent watertube boilers — air-heaters —superheaters and fan application for power installations.

Our business is 63 years old and growing steadily. In a completely equipped modern plant we manufacture one of the most complete lines of boilers and stokers. This is a rare opportunity that warrants investigation by engineers wanting advancement and security. Give us complete personal history and salary expected in first letter.

This position requires residence in Minneapolis.

PERSONNEL DEP'T.,
WM. BROS BOILER MFG. CO.
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WANTED—MASTER MECHANIC to supervise a small mechanical and electrical crew, general plant work. Location Louisiana. Age limit 45. Position permanent. Address Box 1501, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

WANTED—Sales manager experienced in process equipment for liquids and water treating equipment. Location middle west. Write giving age, education, experience, positions held, companies employed by, references. Salary expected. Enclose picture. Box 1502, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Illinois.

DESIGN DRAFTSMEN and Detailers to Work on Steam Turbines. Previous experience desirable but not necessary. Worthington Pump and Machinery Corp., Moore Steam Turbine Division, Wellsville, New York.

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Jenkins PRACTICAL PIPING LAYOUTS 7

How to Plan FUEL OIL PREHEATER AND PUMP CONNECTIONS

Another in the series of basic Piping Layouts prepared by Jenkins Bros.

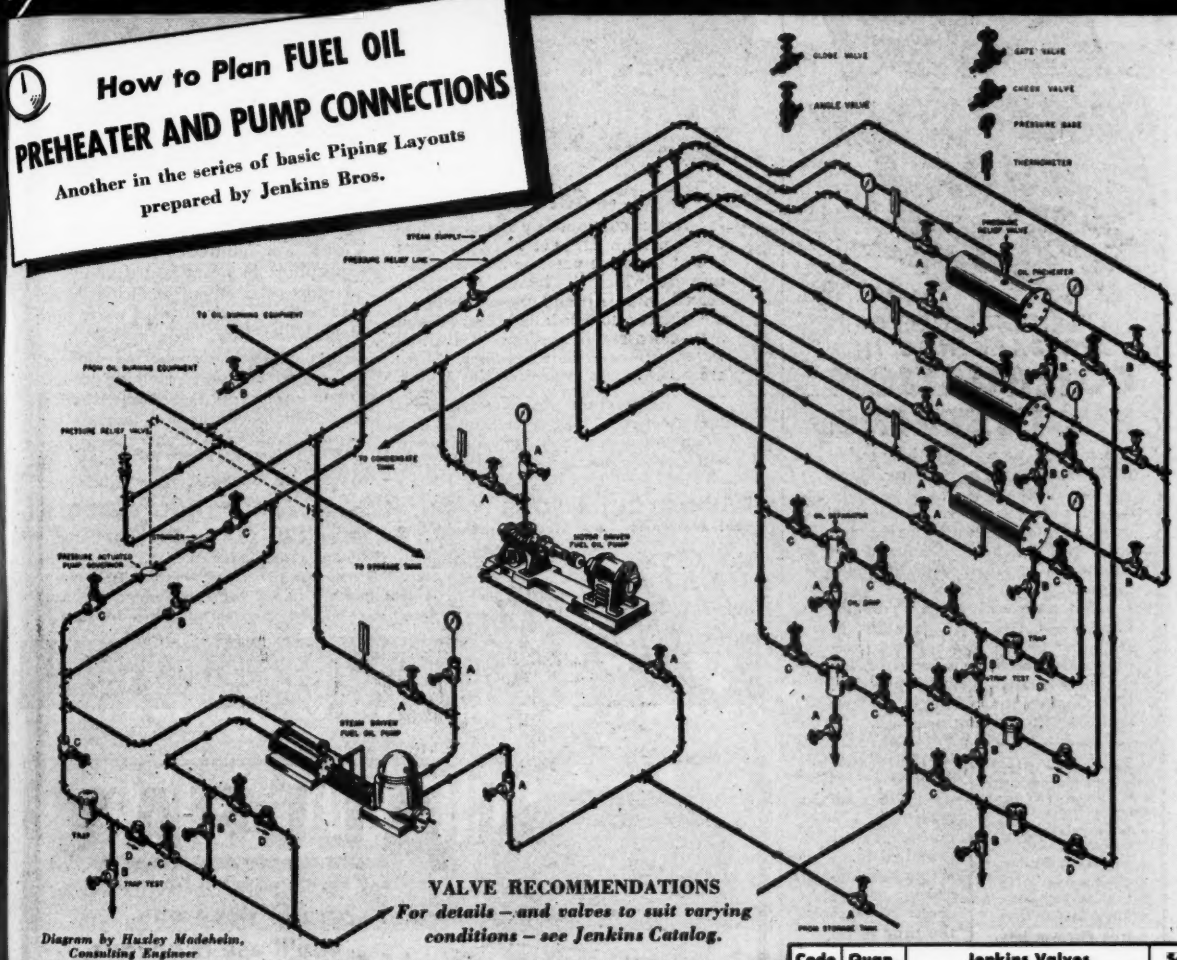

Diagram by Huxley Madeheim, Consulting Engineer

VALVE RECOMMENDATIONS
For details – and valves to suit varying conditions – see Jenkins Catalog.

Code	Quan.	Jenkins Valves	Service
A	16	Fig. 970 Regrind-Renew Br. Globe	Oil Lines
B	13	Fig. 950 Regrinding Br. Globe	Steam Lines
C	15	Fig. 275 O.S.&Y. Br. Gate	Steam Lines
D	5	Fig. 92 Bronze Swing Check	Steam Lines

Preheaters and Pumps are necessary for conditioning fuel oil for furnaces used for heating or power.

Continuous Circulation to and from the burners is provided in this layout showing preheaters and pumps in lines originating at, and returning to the storage tanks.

A Duplicate Installation of fuel oil pumps, one steam and one electric motor driven, allows for continued operation in event of electric power failure. It also permits a choice of motive power to gain the best overall economy.

Any Two Preheaters of the three provided have sufficient capacity to heat the maximum demand of fuel oil, thus allowing the shut down of one for repairs.

Oil Separators are provided to make sure that the return steam from the fuel oil preheaters and the steam cylinder of the pump does not carry fuel oil into the feedwater.

Many Types and Pressure Ranges of Jenkins Valves other than those shown can be used for this type of layout, according to the factors involved. Consultation with accredited piping engineers and contractors is recommended when adapting these suggestions to your own requirements or when planning any major piping installation.

Copies of Layout No. 7 enlarged, with additional information, will be furnished on request . . . also copies of future Piping Layouts. Just fill out and mail the coupon.

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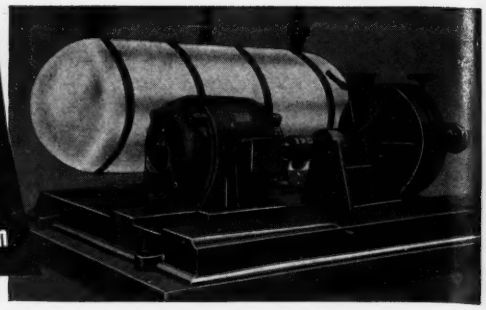

—for Cookers, Heaters, Driers, etc.

It operates continuously returning condensate, ALL OF IT, fast as formed and at the same pressure and temperature at which it leaves the steam heated units. Air and non-condensibles are then automatically removed and the condensate, in the form of distilled water, returned direct to boiler. There are no traps or orifices in the system.

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If you operate steam heated cookers, heaters, driers, ironers, clothing presses, drying ovens, oil tanks, water tanks, pickling tanks or have other uses for so-called "process steam" investigate the Stout NO-VENT Boiler Return System. It can boost your production.

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Heat Reclaimers • Steam Condensers • Spiro Water Heaters • Gas Fired Boilers

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Here's the universal packing that can be used for any fluid or on any apparatus—economically, efficiently—tightly—simply.

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FIRING SYSTEMS • SAWDUST BURNERS

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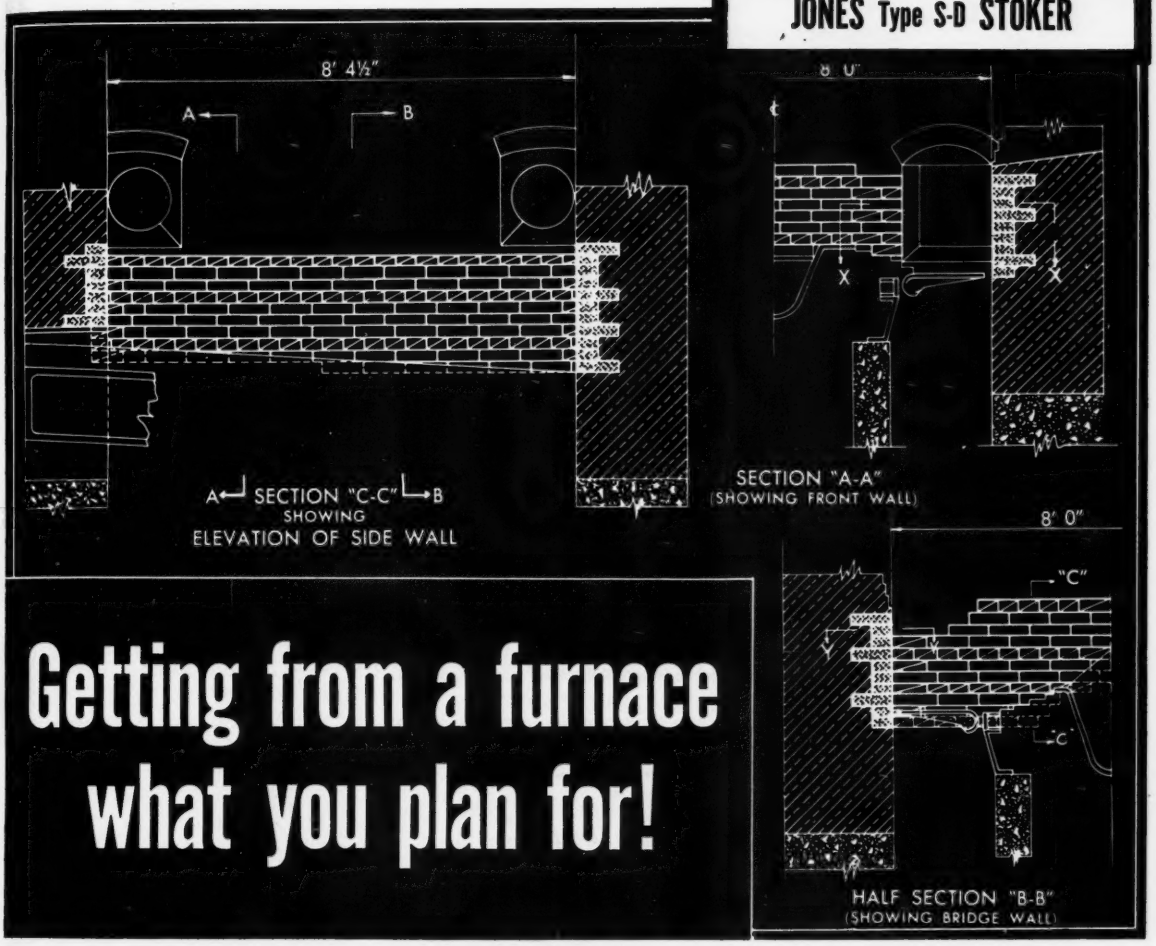
How to increase the steaming capacity of existing boilers is one problem that John Phillips Badenhausen engineers have often solved.

Further information gladly submitted on request

18TH FLOOR, PACKARD BUILDING, PHILADELPHIA 2, PA.

WALL BRICK DATA

JONES Type S-D STOKER



Getting from a furnace what you plan for!

Specifically designed for use with a Jones type S-D Stoker is the CARBOFRAX silicon carbide brick setting shown in the illustration.

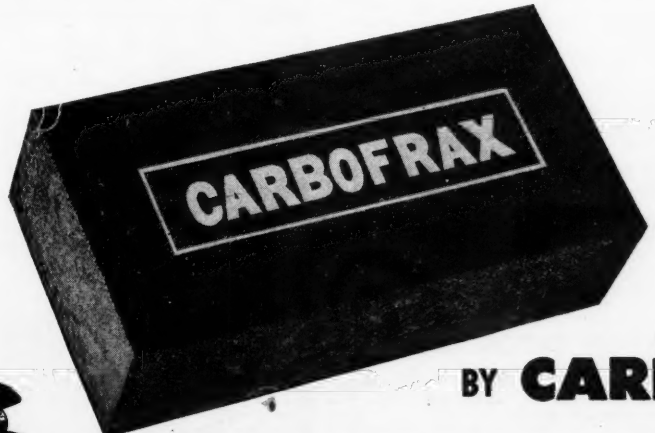
The height of the CARBOFRAX lining may vary depending upon the operating conditions encountered. But through its use greater furnace efficiency will result. Here's why:

1. Greater steaming capacity plus better fuel combustion is provided by full utility of the grate area. Space consuming, troublesome clinkers cannot anchor to the CARBOFRAX brick. Their hard, dense surface is retained at temperatures far in excess of those usually attained.

2. CARBOFRAX brick are extremely resistant to mechanical abrasion, spalling and cracking so that outages for lining repairs are few and far between.

3. With their remarkably long life, 8 to 10 years of steady service is not unusual —CARBOFRAX brick reduce labor and material expense. Since these brick do not burn or cut back, the upper walls are fully supported at all times. This too helps to cut costs.

Ask to discuss CARBOFRAX settings for your boiler furnaces. We will be glad to assist. Or, without obligation, write for a copy of "CARBOFRAX in Boiler Furnaces", to Dept. H-26, The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.



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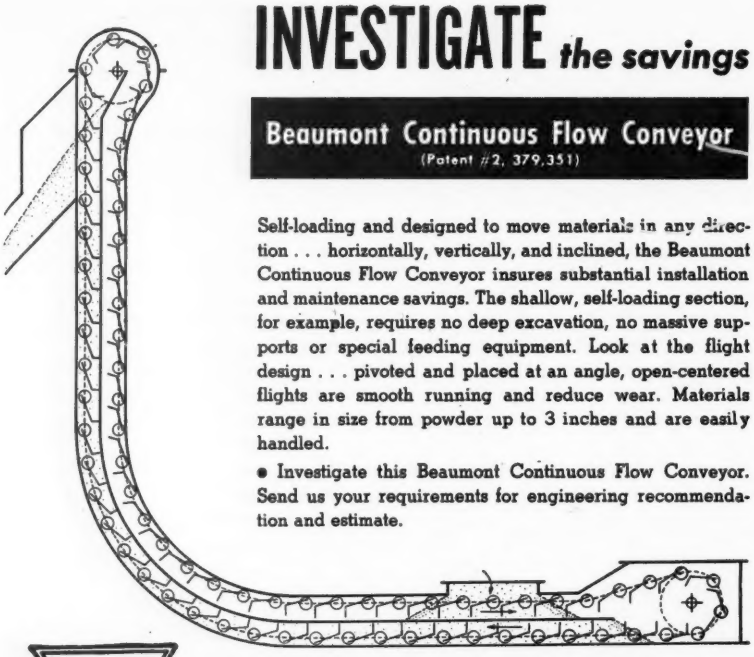

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(Patent #2, 379,351)

Self-loading and designed to move materials in any direction . . . horizontally, vertically, and inclined, the Beaumont Continuous Flow Conveyor insures substantial installation and maintenance savings. The shallow, self-loading section, for example, requires no deep excavation, no massive supports or special feeding equipment. Look at the flight design . . . pivoted and placed at an angle, open-centered flights are smooth running and reduce wear. Materials range in size from powder up to 3 inches and are easily handled.

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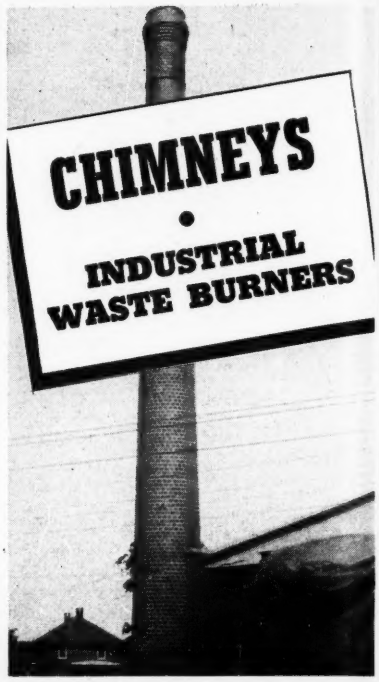

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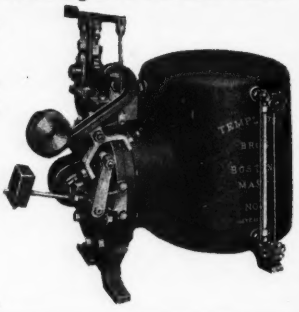

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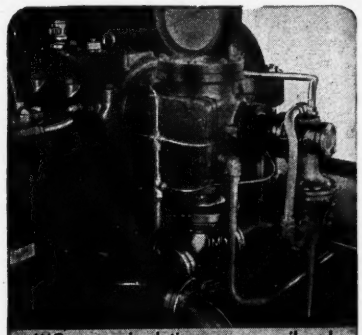

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CROWDED? Install an IMO

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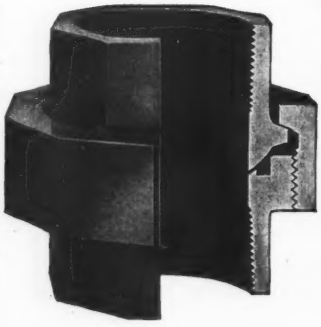

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To date we have reports covering 319 personal visits on power engineer and executive readers in 28 different classes of industries and service establishments in 29 states.

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To assure an accurate reader sample, we not only called on vice-presidents in charge of 100,000 hp central stations in Pennsylvania but also chewed the fat with owners and engineers of 100 hp laundries in Mississippi. Many of the interviews were made at readers' homes—after hours.

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Power Plant ENGINEERING

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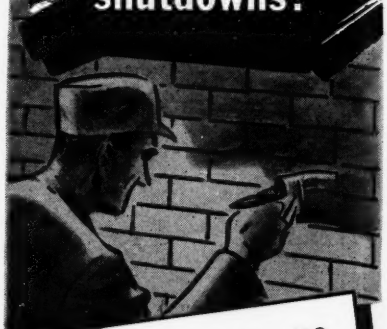

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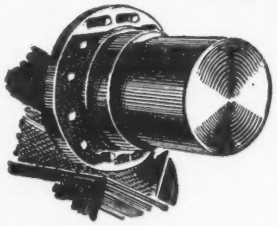

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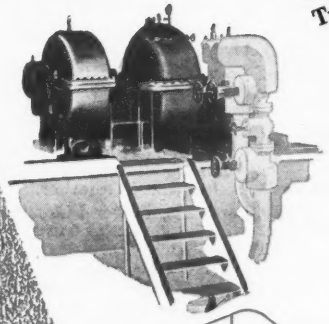

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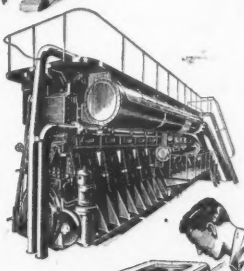

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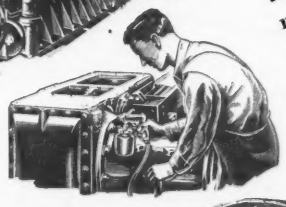

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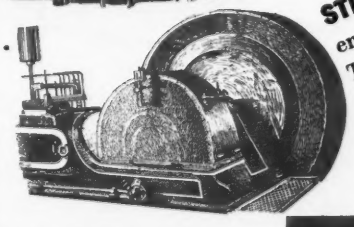

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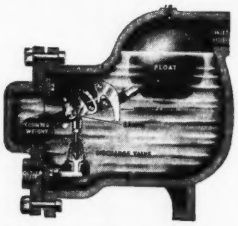
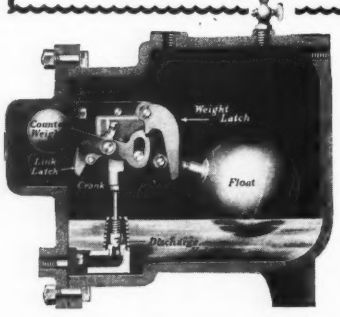
WEIGHT-OPERATED
TRAPS



Offer

OUTSTANDING RECORDS
FOR
DRAINAGE EFFICIENCY



These plant-proved units feature enormous drainage capacity, fast positive action, stainless steel where it counts, and sturdy construction to take the abuse of toughest applications. On their on-the-job records, you can depend solidly on Nicholson Traps to promote efficiency. For every power and process purpose.

Catalog 444 or See Sweet's

W. H. NICHOLSON & CO.
160 OREGON ST., WILKES-BARRE, PA.

ALSO THERMOSTATIC AND PISTON-OPERATED TRAPS FOR STEAM, AIR, GASOLINE

GOVERNMENT-OWNED SURPLUS, UNUSED
ELECTRICAL WIRE and CABLE FOR SALE
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(A Subsidiary of Reconstruction Finance Corporation)

22 BASIC TYPES,
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Several Millions of Feet—in reels and coils

From single (solid or strand) conductors to patterns of 30 conductors. Some rubber and some resin insulation. Some sheathed with flame-proof braid and some with braided metal—others lead sheathed.

Made by leading American manufacturers in accordance with exacting technical specifications for the British Admiralty to be used for electric light and power circuits, telephone circuits, welding, battery charging, instrument wiring, power control circuits, switchboard wiring and degaussing, in the equipping and repairing of ships. Material is unused—condition may be determined by inspection.

ASK FOR 20 PAGE ILLUSTRATED DESCRIPTIVE BOOKLET

Contains complete description of items and photographs of types, and details of submitting offers to purchase on or before February 21, 1946. Call, telephone, wire or write for "Electrical Wire and Cable Booklet".

WAR ASSETS CORPORATION
A Disposal Agency Designated by the Surplus Property Administration
1528 WALNUT STREET, PHILADELPHIA 2, PA.
Telephone: Kingsley 1500 330

GOVERNMENT-OWNED
FLOATING STEAM ELECTRIC POWER PLANT 30,000 KW
FOR SALE OR LEASE

The Reconstruction Finance Corporation, a disposal agency designated by the Surplus Property Administration, or such successor Disposal Agency as may be hereafter designated, invites proposals for the purchase or lease of the following property in the interest of continued employment. This property was acquired by an agency of the government for production in the war effort, and is now, or shortly will be, declared surplus to government needs.

Listing of this plant by name of lessee is for identification purposes only, and has no connection with the lessee's own plant or facilities.

Philadelphia, Pennsylvania
(Plancor 525)
Floating Power Plant
"Sea Power"

This is a complete modern steam electric generating station with a water and fuel rate comparable to modern fixed electric stations. The plant is equipped with a sea going hull suitable for towing from one location to another.

The Power Plant is contained on a barge 318 feet in length, 50 feet in width, 9 feet draft with sufficient fuel oil storage for seven days operation at full capacity.

General Electric Turbo Generator (condensing) 30,000 KW capacity at .8 power factor, 3 phase, 60 cycles, 13,800 volts. Equipped and capable of delivering 24,000 KW at .8 power factor, 50 cycles.

General Electric 37,500 KVA transformer, 13.8 KV Delta to 63/69 KV Wye or 115/132 KV Wye.

Two Babcock and Wilcox boilers with steam capacity of 170,000 pounds/hour, each at an operating pressure of 825 pounds/sq. inch and operating temperature of 900 degrees F. Equipped for burning fuel oil or natural gas.

CREDIT TERMS MAY BE ARRANGED FOR THE PURCHASE OF THIS PLANT.

General information is available from your nearest RFC office. For specific data, contact the office indicated below. All data contained herein are necessarily abbreviated and subject to correction. They are not intended for use as a basis for negotiation. RFC reserves the unqualified right to reject any or all proposals or offers received for the above property.

RECONSTRUCTION FINANCE CORPORATION
Surplus Property Division
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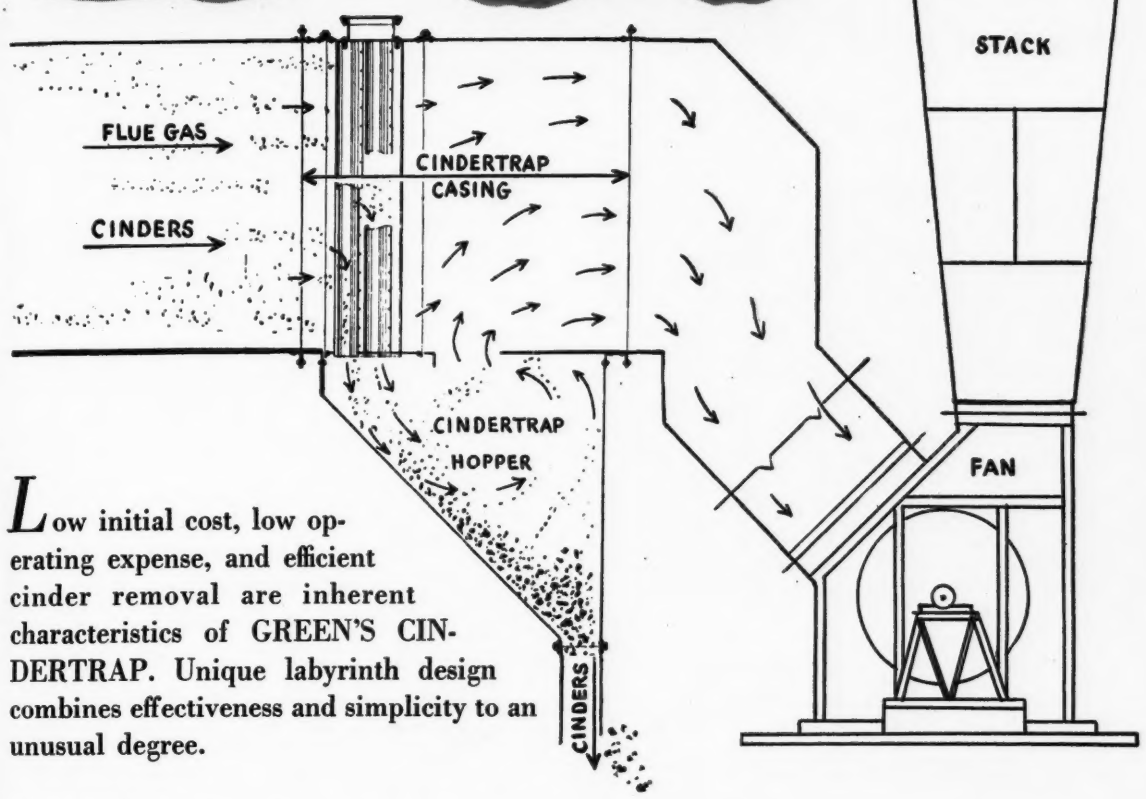
CATCH CINDERS .... at Low Cost!



Low initial cost, low operating expense, and efficient cinder removal are inherent characteristics of GREEN'S CINDERTRAP. Unique labyrinth design combines effectiveness and simplicity to an unusual degree.

EFFECTIVE: Traps from 75% to 96% of the cinders in flue gas.

Unaffected by variations in cinder concentration.

Patented design prevents clogging.

ECONOMICAL: Low initial cost . . . long life.

Fits readily into existing systems.

No moving parts . . . no water spray.

No replacement parts have ever been required.

Low draft loss (0.2" maximum).

Efficient for stokers.

For complete details send for Bulletin 163-A

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THE GREEN Fuel Economizer COMPANY INC.

BEACON 2, NEW YORK

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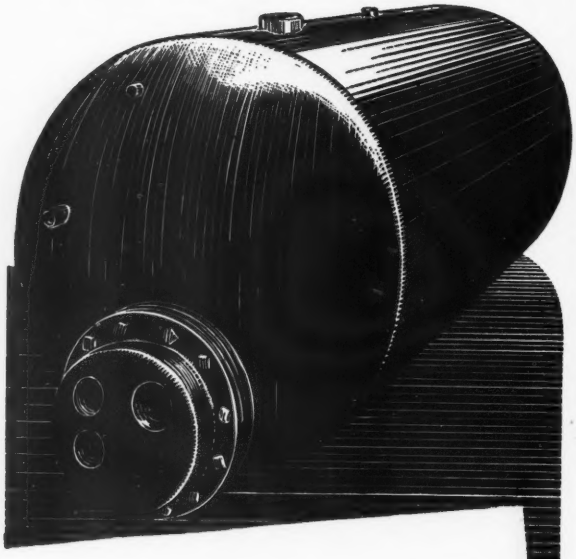
ADSCO

HEAT EXCHANGERS



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men who know
HEAT TRANSFER

The talent and experience that goes into ADSCO equipment is responsible for the performance you get out of it. ADSCO Liquid Heaters and Coolers are made in a complete line of standard and custom-made horizontal and vertical types with semi-steel shells or fabricated from steel plate, and special materials such as Copper Silicon Alloy, Toncan Iron, Nickel Clad Steel and other special materials which answer exacting requirements of modern processing. Correspondence is invited regarding any liquid heating or cooling requirement. Write for Bulletin No. 35-76 E

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NORTH TONAWANDA, N.Y.
MAKERS OF UP-TO-DATE STEAM LINE EQUIPMENT FOR OVER 65 YEARS

POWER PLANT *Construction News*

Alaska, Sitka—Town Council, E. M. Goddard, mayor, has tentative plans for new municipal hydroelectric power plant, with initial installation of two hydraulic turbines, two 1000-kw generators, and auxiliary equipment. Extensions will be made in transmission lines. Entire project will cost about $518,000. Financing in part will be arranged through Federal aid. Proposed to engage engineer soon to prepare detailed plans.

Calif., San Bernardino—Bd. of County Supervisors, San Bernardino, has plans under way for new steam power plant, 76 x 77 ft, at county hospital, for central-heating service, with underground steam mains for service to about 20 buildings. No estimate of cost announced. Proposed to carry out work soon. Stockley & Bamford, 124 West Fourth St., Los Angeles, Calif., are engineers.

Calif., San Jose—Beechnut Packing Co., Canajoharie, N. Y., canned food products, is completing plans for new three-story processing and packing plant at Phelan Ave. and Center Rd., San Jose. Electric power equipment will be installed. A steam power plant will be built. Entire project will cost about $750,000. Proposed to begin work soon. Binder & Curtis, 35 West San Carlos St., San Jose, are architects.

Conn., Hartford—Connecticut Light & Power Co., 36 Pearl St., plans expansion in power plants and system during next five years to cost approximately $25,000,000, including additions to present generating stations, new power substations, transmission and distributing lines, and other facilities. Program for current year is now being arranged.

Del., Wilmington—Delaware Power & Light Co., 600 Market St., has plans under way for new steam-electric generating station in Cherry Island district, on Delaware River, where tract of about 235 acres of land has been selected. Installation will include turbine-generators with total rating of 90,000-kw, high-pressure boilers, condensers and auxiliary equipment. Proposed to begin work soon and to have station ready for service in about 24 months. Extensions will be made in transmission lines. Entire project is estimated to cost about $13,000,000.

Ill., Chicago—Publishers, "Chicago Sun," daily newspaper, 400 West Madison St., plans installation of electric power equipment in new four-story printing and publishing plant on block bounded by Madison, Market and Monroe Sts., and Chicago River, about 178 x 378 ft, totaling 336,000 sq ft floor space. Proposed to begin erection soon and have structure completed by July, 1947. Cost estimated over $7,000,000. Shaw, Naess & Murphy, 80 East Jackson Blvd., are architects.

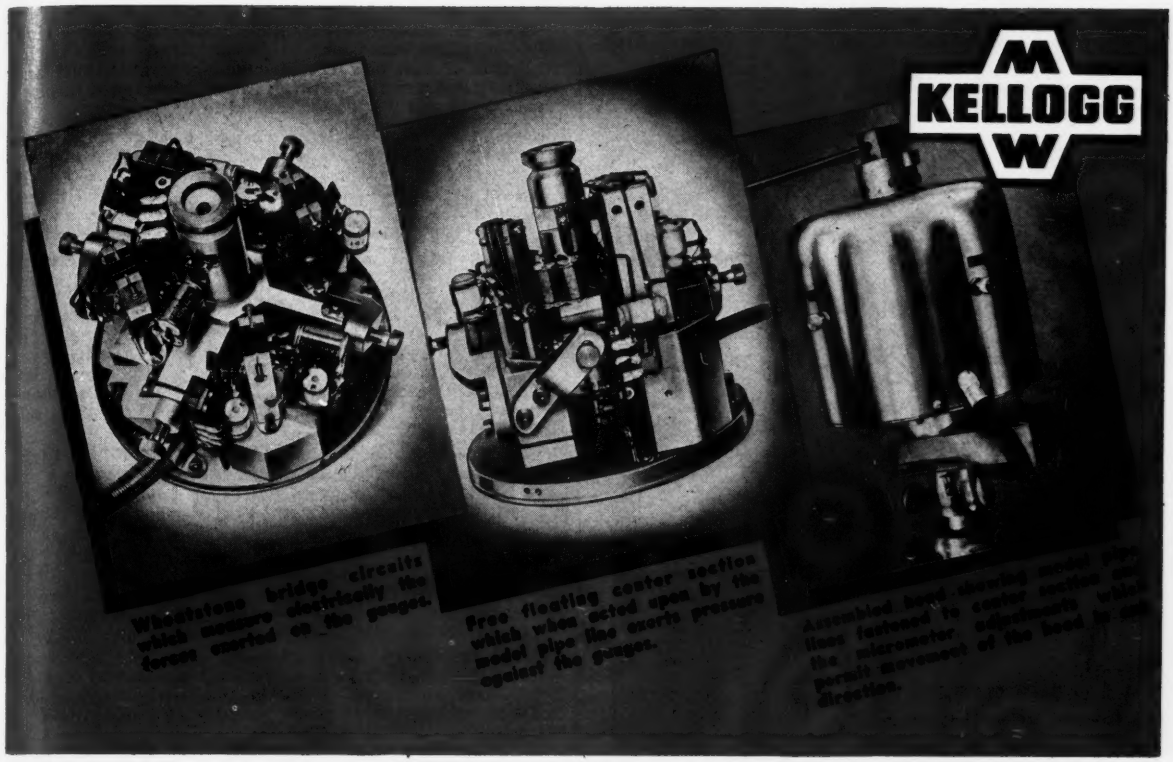
Ill., Libertyville—Seng Co., 1450 North Dayton St., Chicago, Ill., furniture hardware, plans installation of electric power equipment in proposed new one-story plant, about 175,000 sq ft floor space at Libertyville, where site is being selected. Cost over $450,000, with machinery.

Ill., Freeburg—Municipal Light Department has plans under way for extensions and improvements in municipal power plant. Proposed to begin work soon. No estimate of cost announced.

Ill., La Grange—Electro-Motive Div., General Motors Corp., La Grange, Diesel-electric locomotives, has plans nearing completion for new power house at plant, estimated to cost about $750,000, with equipment. Proposed to begin work soon. Schmidt, Garden & Erikson, 104 South Michigan Ave., Chicago, Ill., are architects.

Ind., Goshen—Bd. of Public Works, R. M. Kitson, secretary, has plans under way for expansion and improvements in municipal power plant, including installation of new Diesel engine-generating unit, 1500 to 2000-kw rating, and auxiliary equipment. Entire program reported to cost about $500,000. Burns & McDonnell Engineering Co., 107 West Linwood Blvd., Kansas City, Mo., is consulting engineer.

Iowa, Davenport—Eastern Iowa Light & Power Cooperative, Davenport, will have plans prepared at once for new steam-electric generating station. Surveys and estimates of cost are being made. Stanley Engineering Co., Muscatine, Iowa, is consulting engineer.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W
Wheatstone bridge circuits which measure electrically the forces exerted on the gauges.
Free floating center section which when acted upon by the model pipe line exerts pressure against the gauges.

These Heads Measure Load Deflections to ONE-MILLIONTH of an INCH

These super-sensitive instruments were designed and are used exclusively in the Kellogg Engineering Department for the benefit of Kellogg piping clients.

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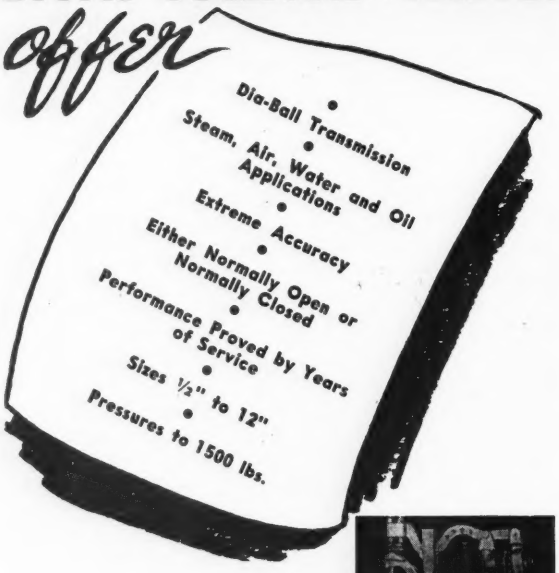
DAVIS SOLENOID VALVES



The Davis COMPLETE line of Solenoid Valves has proved itself year after year by meeting all kinds of operating conditions in the automatic distant controlled valve field. Davis types of steam, air, water and oil valves adapted to solenoid operation include single seated valves for high or low pressures, balanced valves, butterfly valves and three or four-way pilot valves. They are of the reciprocating or rotary stem type, and are made explosion proof when desired. The Davis Dia-Ball packless, leakproof transmission is also available on Davis solenoid valves. This construction is recommended for use with vacuum containers or when volatile or highly explosive liquids are handled.

The Davis Two-Step Solenoid Valve is designed to meet requirements of extreme accuracy.

There is a Davis Solenoid Valve to meet your specifications, whatever they may be. Write today for information!

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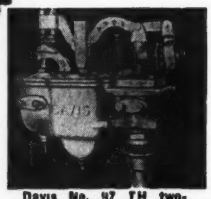
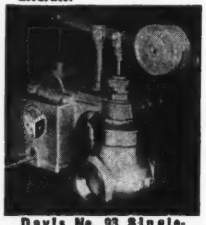
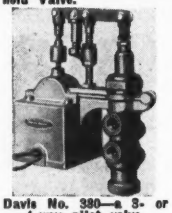


Davis No. 97 TH two-step Solenoid Valve. For proportioning or throttling of liquid flow. Extremely accurate.



Davis No. 93 Single-Seated Pilot-Stem Solenoid Valve.



Davis No. 380—a 3- or 4-way pilot valve.

Davis No. 93-H with Solenoid operated pilot valve and hydraulically actuated main valve.

DAVIS VALVES
DAVIS REGULATOR CO.

Iowa, Glidden—Glidden Rural Electric Cooperative, Glidden, plans extensions in power plant, including installation of two new Diesel engine-generator units and auxiliary equipment. Financing has been arranged through Federal aid and work is scheduled to begin soon.

Kan., Kansas City—Sealright Co., Fairfax and Rickel Rds., bottle caps and closures, plans installation of electric power equipment in new one-story addition, 200 x 271 ft. Cost over $250,000, with machinery. Proposed to begin work soon. Charles E. Keyser, 609 Minnesota Ave., is architect. Main offices of company are at Fulton, N. Y.

Ky., Louisville—Veterans' Administration, Vermont Ave., H and I Sts., Washington, D. C., plans new general medical and surgical hospital at Louisville, where site of 59 acres of land has been secured in Melwood Ave., outside Eastern city limits. It will comprise large group of one and multi-story institutional buildings, with power house, ice and refrigerating plant, outside electrical distribution lines and other utilities. An air-conditioning system will be installed. Fund of $4,577,129 has been authorized for project.

Mass., New Bedford—New Bedford Gas & Edison Light Co., plans addition to electric generating station on Cannon St., with installation of additional equipment for increased capacity. No estimate of cost announced. Erection of steel frame superstructure will begin soon.

Minn., Plainview—Common Council is considering installation of a municipal power plant. A committee has been appointed to investigate feasibility and determine estimated cost. Proposed to use Diesel engine-generator unit and accessories. J. L. Baldwin is mayor.

N. J., Elizabeth—Apex Chemical Co., Inc., 200 South First St., industrial chemicals, plans installation of electric power equipment in connection with proposed rebuilding of portion of plant recently destroyed by fire, with loss reported over $350,000.

N. J., Sewaren—Public Service Electric & Gas Co., Public Service Terminal, Newark, N. J., has plans maturing for new generating station at Sewaren, where tract of 144 acres has been selected with frontage on Arthur Kill waterway. Installation will include two 100,000-kw hydrogen-cooled turbine-generators, high pressure boilers, surface condensers of 55,000 sq ft capacity and auxiliary equipment. Large switchyard will be built and new 132,000-volt transmission system constructed. Proposed to begin work this fall and to complete project in about 24 months. Cost estimated over $22,000,000.

N. C., Morganton—Town Council plans extension in water system, including new pumping station, with motor-driven pumping units, controls and auxiliary equipment. Also new filtration plant and main supply pipe line. Cost estimated about $172,000. Work will be carried out soon.

N. D., Fargo—Minnkota Power Cooperative, Inc., Grand Forks, N. D., has plans maturing for new power plant in vicinity of Fargo, where site is being selected, with rated capacity of 4800-kw, divided into three Diesel engine-generating units and auxiliary equipment. Also will build six new power substations at different points. Entire project is reported to cost about $700,000. Financing has been arranged through Federal aid.

N. D., Minot—Northern States Power Co., Minneapolis, Minn., plans early construction of new power plant on Central Ave., Minot, to be used for auxiliary service. Station will be equipped with two 750-kw Diesel engine-generator units and auxiliaries. Cost estimated about $850,000. Line extensions also are planned in same area.

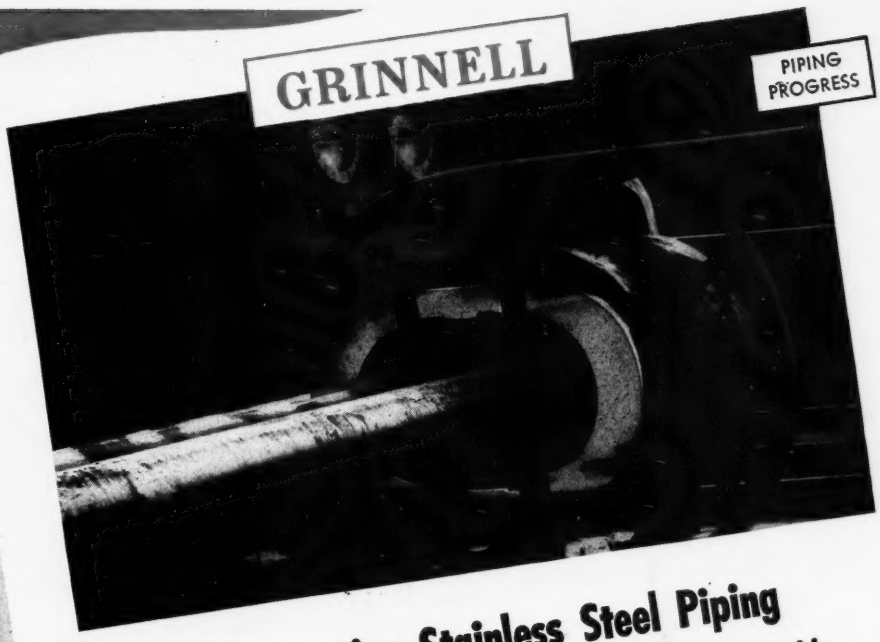
S. D., Mitchell—Town Council has plans under way for central municipal steam-generating station, to be used for heating service, including distribution lines in downtown area. Cost about $260,000.

Texas, San Benito—Central Power & Light Co., Corpus Christi, has approved plans for expansion in steam-electric generating station at San Benito, with installation of new 20,000-kw turbine-generator unit and accessory equipment. Also will build new machine shop. Extensions will be made in transmission lines. Entire project reported to cost about $2,225,000. Work scheduled to begin at once.

Wyo., Casper—Bureau of Reclamation, Casper, is asking bids until March 12 for construction of Kortes dam and hydroelectric generating station, Kortes Unit, Missouri Basin project, about 62 mi from Casper. Work includes station building, penstocks, traveling and gantry cranes, transformer transfer car, valves and fittings, and other facilities (Specifications 1151).

GRINNELL

PIPING PROGRESS



Heat Treating Stainless Steel Piping

Question: **Why might it be necessary to heat-treat unstabilized chromium-nickel alloy steel pipe after fabrication?**

Answer: **To eliminate precipitated carbides which decrease the corrosion-resisting quality of the steel.**

Heat treating consists of heating the prefabricated pipe at a predetermined rate to a specified temperature, maintaining such temperature for a certain time and then cooling at another predetermined rate. The picture above illustrates heat treating welds on a 180° bend in a modern muffled-type gas furnace.

WHENEVER **PIPING** IS INVOLVED

There are many types of alloy steel – each with its own particular properties and characteristics, such as reactions under the heat of welding and bending. Grinnell engineers are familiar with these reactions and have developed closely controlled and metallurgically supervised procedures for fabricating alloy piping to obtain the full advantages of alloy steels for corrosion resistance and for high pressure and high temperature applications.

Whatever the piping requirements, Grinnell has the specialized engineering knowledge and experience to handle the job – from first plan to actual operation. Grinnell can supply everything from a tiny tube fitting to a complete power plant installation.

GRINNELL COMPANY, INC. Executive Offices, Providence 1, R. I. Branch warehouses in principal cities. Manufacturing Plants: Providence, R. I.; Cranston, R. I.; Atlanta, Ga.; Warren, Ohio; Columbia, Pa.

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WHENEVER PIPING IS INVOLVED

. . . Provide Four Point Security

Here are FOUR TANGIBLE REASONS why Phoenix Flanges will give you the utmost in safety, service, and satisfaction:

1. They're drop forged so that grain flow of the metal is positioned to provide maximum strength and toughness in those portions of the forging where it is most needed.
2. They're made of mild steel especially adaptable to welding and machining, and are available in a wide range of styles and sizes. Phoenix Flanges made of stainless steel, Everdur brass, and other alloys are also obtainable, on special order.
3. They're both Normalized and Annealed for long wear and strength, in precision-controlled heat treating furnaces.
4. They're lacquer finished to resist rust and corrosion.

Every Phoenix Flange complies with ASA requirements and ASME and ASTM specifications.

For safety, service, and satisfaction specify Phoenix Flanges. Write for your free copy of the new Phoenix Flange Catalog today.

Flange Division of

PHOENIX MANUFACTURING COMPANY

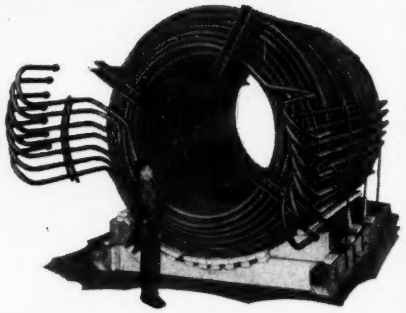
CATASAUQUA, PA. JOLIET, ILL.

An Easy Way to Solve Heat Transfer Problems

If you have a heat transfer problem that's tough, there is a solution.

Rempe engineering and manufacturing service, backed by 57 years' experience, is available to you.

This service starts with the design and selection of materials best suited to the particular job and follows through all manufacturing operations to final thorough testing.



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Take advantage of our free engineering service by sending details on your heat transfer problems. Write today.

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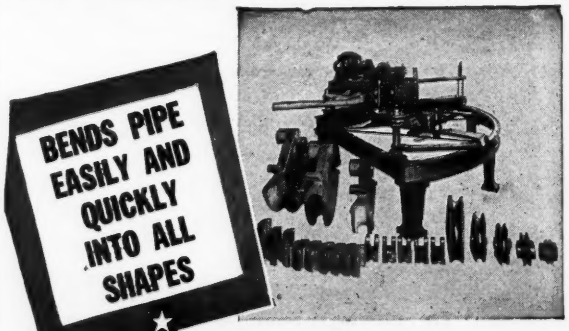

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Twelve types to select from. **Hand operated capacities ⅛ to 6" inclusive. Motor operated ¾ to 8" inclusive.**

A few of our More Than 12,000 Customers:
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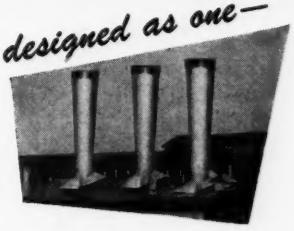
Quick Deliveries

16 FURNACE ST. POULTNEY, VT.

a 3 in 1 unit

FAN-BREECHING-STACK

designed as one—

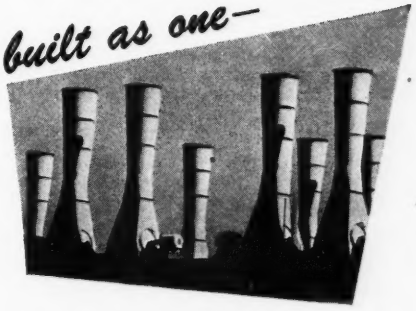


Mounted directly at the boiler outlet, the Thermix Fan-Stack eliminates necessity for expensive stack supporting structure. This installation method also obviates the necessity for the usual type of breeching to stack, to which many costly draft losses can be traced.

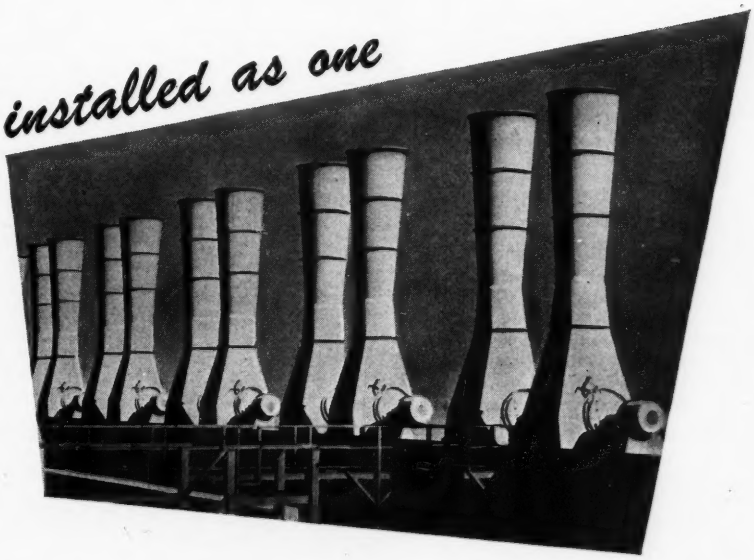
The Thermix Stack is of the divergent type. The dynamic energy in the gas is converted to the necessary static energy, thus assuring maximum operating efficiency.

Check your boiler draft situation—now! It will cost you nothing to let Thermix field engineers make their recommendations. Countless cases throughout industry prove that it may pave the way for an improvement in efficiency, or even an increase in steam output with your existing boiler that will come as a pleasant—and profitable—surprise.

built as one—



installed as one



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Use STONHARD RESURFACER for your rutted and worn floors, platforms and trucking aisles. There's no skilled labor problem. No ripping or cutting up of the old surfaces will be necessary. Tough, yet resilient, patches or complete overlays can be applied over concrete, wood, brick or composition.

Repair or entirely resurface your old, dried-out and leaky roofs with STONHARD LIQUID and PLASTIC ROOF RESURFACERS. No laps, joints or nail holes will remain to trouble you. Because they are applied cold, there is no involved preparation of materials. Can be applied over any type of roof surface, flashings and gutters.

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MAGIC BOILER PRESERVATIVE

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"MAGIC" Boiler Preservative has the big advantage of being non-volatile. It will not evaporate or distill over with the steam.

The steam from boilers using "MAGIC" is pure and free from any chemicals or injurious gases. It can be used directly in processing industries without injury to products.

Remember, too, that "MAGIC" puts a protective film on the iron which not only prevents scale from adhering, but also helps to prevent pitting, corrosion and leaks.

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Established 1904

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OF NEW YORK, Inc. — 1328 Broadway, New York City 1

OF CALIFORNIA — 148-156 Spear St., San Francisco 5

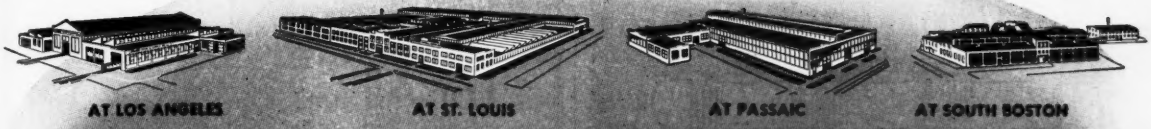
The Lyons Chronometric Hand Tachometer is designed to provide exceptionally precise measurement of constant rotary and linear speeds.

Produced in two types, 0 to 1000 RPM and 0 to 10000 RPM, graduated in 1/5 RPM and 2 RPM subdivisions respectively, the Lyons has an overspeed allowance of 100%, is durable and entirely trustworthy.

BOULIN INSTRUMENT CORPORATION

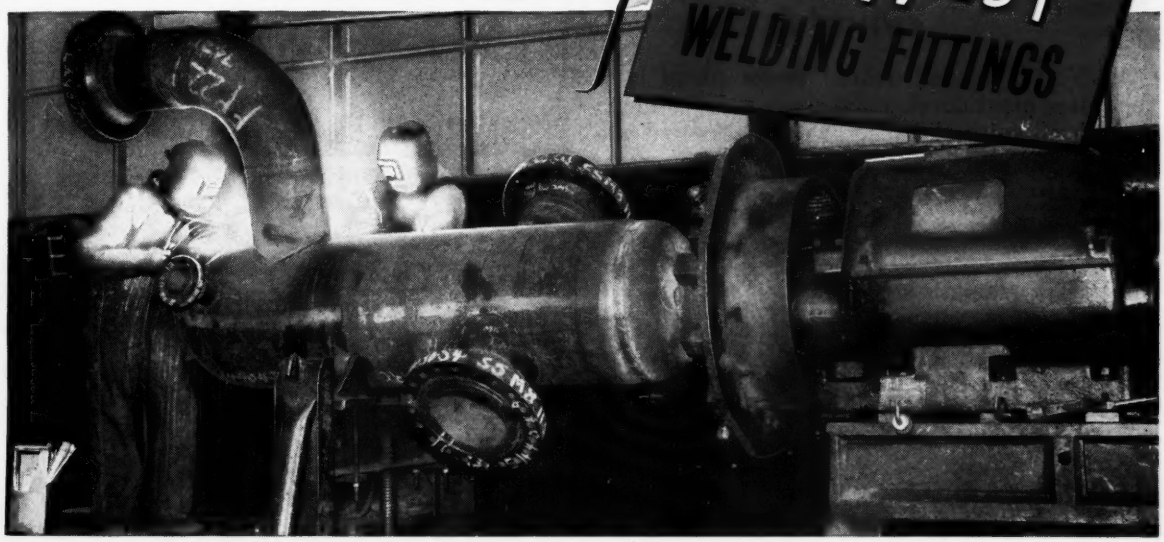
PORTABLE AND STATIONARY CENTRIFUGAL TACHOMETERS
PORTABLE CHRONOMETRIC AND STROBOSCOPIC TACHOMETERS

65 MADISON AVENUE, NEW YORK, N. Y.



AT LOS ANGELES AT ST. LOUIS AT PASSAIC AT SOUTH BOSTON

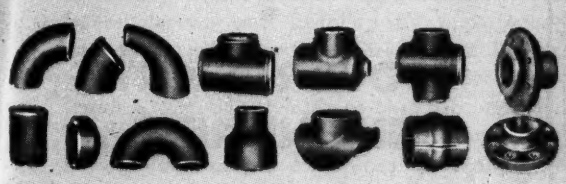
MIDWEST PIPE FABRICATING PLANTS Make a CONTINUOUS CHECK on the HIGH QUALITY of MIDWEST WELDING FITTINGS



Four modern Midwest pipe fabricating plants supply piping for all purposes and pressures to a great variety of industries from coast to coast. These Midwest plants are large users of Midwest Welding Fittings. This regular everyday use of these fittings in fabricating both simple and complex piping subassemblies provides an accurate and continuous check of their quality . . . of correct dimensions . . . of uniformity . . . of accurate angularity, etc.

But this daily use in our own fabricating plants does more than check quality . . . it makes certain that Midwest Fittings are thoroughly practical . . . that they meet the needs of modern piping practices from a design standpoint . . . that they are easy to lay out and weld. For example: the accuracy of Midwest machining methods makes it possible for the user to cut his pipe before receiving his Midwest Welding Fittings . . . he can depend upon the catalog dimensions. Buyers of Midwest Welding Fittings get the benefit of this unique situation. We sell you the same fittings we use . . . assuring you of quality fittings that are correctly designed and that save time and money on many different kinds of piping jobs. Bulletin WF-41 gives all the facts; ask for a copy.

MIDWEST WELDING FITTINGS IMPROVE DESIGN AND REDUCE PIPING COSTS

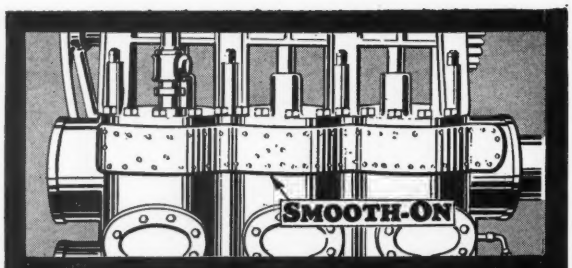


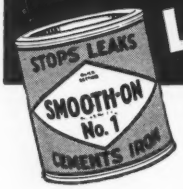
MIDWEST

PIPING & SUPPLY COMPANY, Inc.

Main Offices: 1460 South Second St., St. Louis 4, Mo.

Sales Offices: New York 7—30 Church St. • Chicago 3—645 Marquette Bldg. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. • Atlanta 3—Red Rock Bldg. • South Boston 27—426 First St. • Distributors in Many Cities





LEAKING STOPPED

in badly cracked cylinder block

A 15"x12" triplex geared power pump in a Tennessee plant developed a crack that extended through all valve chambers, valve decks and one partition between plunger cylinders. The typical Smooth-On repair shown here put the pump back in service.

First, the entire crack was filled in with Smooth-On No. 1 Iron Repair Cement. Then a shaped metal patch, coated with Smooth-On, was bolted through valve chamber covers and valve decks into solid iron. After the Smooth-On had hardened, the pump resumed operation without leakage.

For more than 50 years Smooth-On No. 1 has been a standby with mechanics, repair and maintenance men for sealing cracks, stopping leaks and tightening loose parts. Economical. Easy to use. Gives lasting results. Applied like putty, it sets to metallic hardness, expanding slightlty, insuring tight repairs.

Order 1-, 5-, 25-, or 100-lb. sizes from your supply house. If they haven't it, write us.

FREE POPULAR REPAIR HANDBOOK

40 pages. 170 diagrams. Clear instructions for many short-cut, practical, tested repairs to plant equipment. Pocket size—and should be in the pocket of every engineer and mechanic. Yours, for just sending the coupon.

Sign and Send Now

Smooth-On Mfg. Co., 570 Communipaw Ave., Jersey City 4, N. J. Dept. 31
Please send me a Smooth-On Handbook

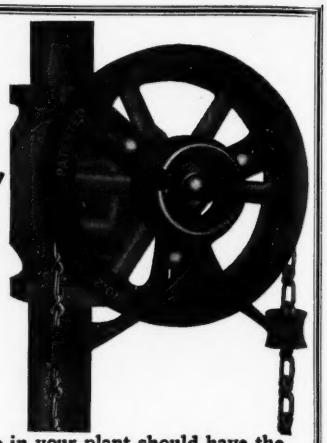
NAME.....

ADDRESS.....

2-46 .....

Do it with **SMOOTH-ON**
The Iron Repair Cement of 1000 Uses

For All "HIGH-UP" VALVES



Every overhead valve in your plant should have the easy, safe, instant control from the floor which Babbitt Sprocket Rims provide. . . . Babbitt Rims are low in cost; quickly attached; they save time, steam and accidents. Install them now. Write for descriptive folder.

BABBITT STEAM SPECIALTY CO.
South Water, Spring and First Sts.
New Bedford, Mass., U. S. A.

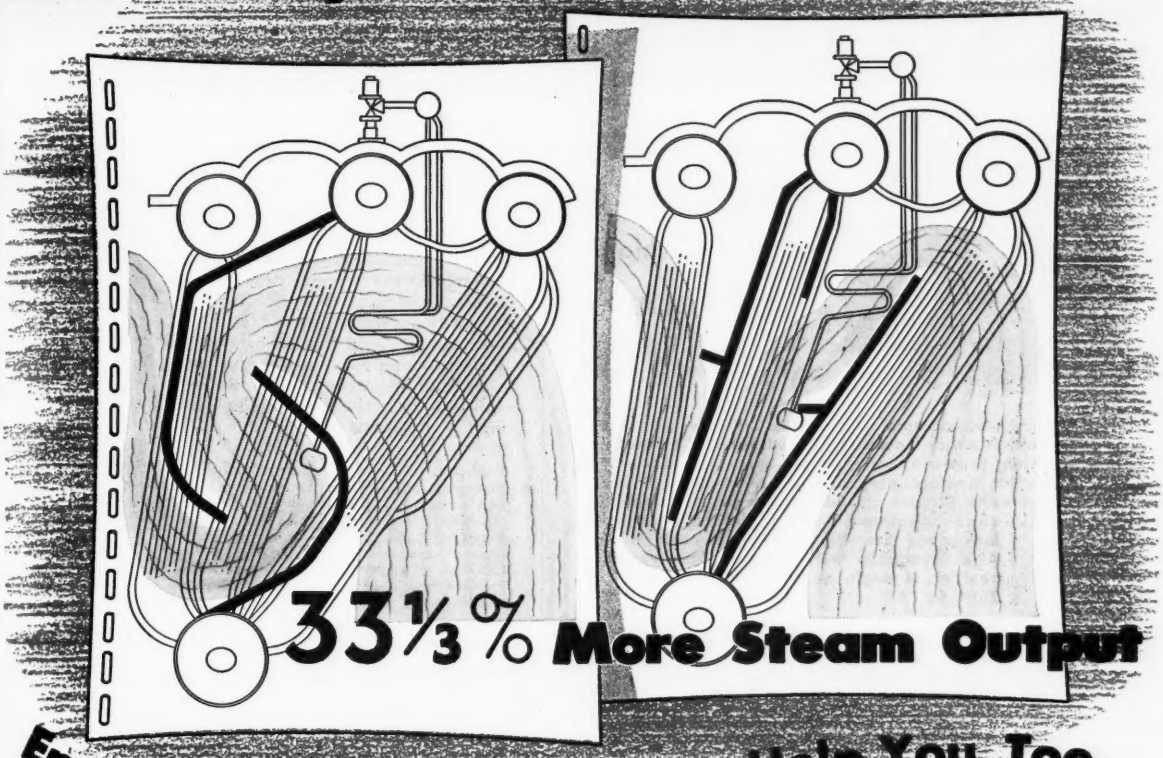
Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

CHANGE OF ADDRESS

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

POWER PLANT ENGINEERING

Case History Shows:



33⅓% More Steam Output

Enco Streamlined Baffles Can Help You, Too.

A recent engineering service report on the efficiency of a large steel plant boiler uncovered this striking fact . . . **Enco Streamlined Baffles boosted steam output 33⅓%.**

Before the Streamlined Baffles were installed, the boiler had difficulty in producing 60,000 pounds of steam an hour. Now, according to the company's chief engineer, "We have no difficulty in obtaining an output of 80,000 to 85,000 pounds of steam an hour."

This is no miracle. Enco Streamlined Baffles are designed to maintain a cross-flow of gases across the tube banks. They are smoothly curved to insure a uniform, high-velocity gas flow over every square foot of heating surface. Bottle-necks, dead gas areas, soot pockets are eliminated; draft-loss is cut to a minimum. The result — more efficient, economical heat transfer.

Especially engineered to suit each particular boiler design, and installed by experience-trained Enco crews, Enco Streamlined Baffles provide for easy tube replacement, low maintenance cost, adaptability to bent tube boilers. You can expect a higher efficiency from your boiler — a substantial increase in steam production — by installing Enco Streamlined Baffles. Call or write for the 18-page Enco Bulletin — BW-44. There's no obligation.

THE ENGINEER COMPANY ALSO PRODUCES:

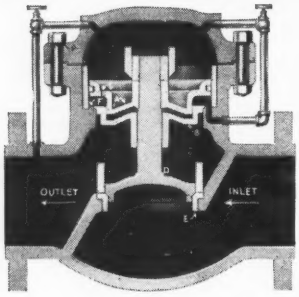
Enco Oil Burners — Steam or Mechanical Atomizing Types.
Enco Air Registers.
Enco Fuel Oil Pumping and Heating Units.
Enco Automatic Oil-Electric Ignition System.
Enco Automatic Combustion Control.

THE ENGINEER COMPANY
75 West Street
New York 6, New York

Canadian Representative:
F. J. Raskin, Inc., 370 Rachel E., Montreal, P. Q.

EC - 461

Engineered PROTECTION for HIGH PRESSURE BOILER FEEDLINES



Golden Anderson HYDRAULIC Double Cushioned Check VALVES

An excellent example of the outstanding engineering built in every Golden-Anderson Valve. Designed for high pressure boiler feed lines, the double cushioning feature prevents any shock or jar in sudden valve closure. Needle valve control allows close adjustment to regulate the operating speed for any operating condition. Also available with manual handwheel control, in angle or globe patterns, sizes 2½" to 14".

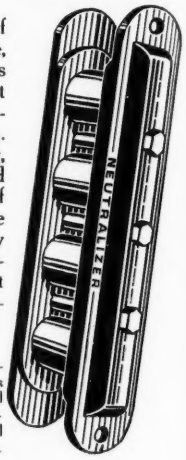
GA

GOLDEN-ANDERSON VALVE Specialty Company
FULTON BUILDING • PITTSBURGH 22, PA.

CASE Histories: Boiler Maintenance

"Neutralizers Eliminated Many Headaches"

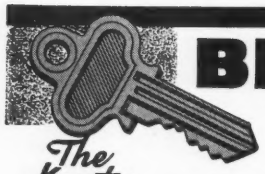
That is what Joseph Unger, Chief Engineer, Chain Belt Co., Milwaukee, wrote, who had been using compounds and chemicals before. Others report important savings in fuel cost, stoppage of corrosion, better steam. Electro-Neutralizers are self-cleaning, automatic, guaranteed, proven and insured, and meet all requirements of Steam Boiler Inspection and Insurance Companies. Sold by leading Supply Jobbers nation wide, or write for literature and recommendations without obligation. Electro Chemical Engineering Co., Louisville 2, Ky.



Controls pH value of water automatically Removes old scale, lengthens boiler life, increases steam efficiency, reduces repair cost. Cuts fuel consumption from 15% to 25%. Stops the eating of metal, pitting, foaming, carry-over and all types of corrosion including electrolytic action. Produces mineral-free water and pure steam, prevents new scale formation regardless of cause or type.

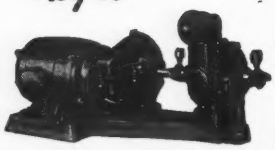
ELECTRO CHEMICAL ENGINEERING CO., LOUISVILLE 2, KY.

ELECTRO-NEUTRALIZER
FOR WATER CORRECTION AND POSITIVE BOILER-SCALE ELIMINATION



BLACKMER PUMPS

The Key to



- LOWER PUMPING COSTS
- SUSTAINED PUMPING CAPACITY
- PUMP DEPENDABILITY

Write for Bulletin No. 307—FACTS ABOUT ROTARY PUMPS—which explains why the "Bucket Design" (swinging vane principle) maintains pumping capacity by automatically compensating for wear and how the buckets, when finally worn out, are easily replaced and the pump restored to its normal capacity.

SERVING INDUSTRY FOR OVER 40 YEARS

BLACKMER PUMP COMPANY, 2010 Century Avenue, Grand Rapids 9, Michigan

POWER PUMPS • HAND PUMPS • EZY-KLEEN STRAINERS

666,000 Is a Lot of Floats,

but that number of Hercules Seamless Floats is now in service. We've been making them since 1894, selling them with a full year's guarantee to stand up under as high as 350 lbs. working pressure and 500 degrees temperature. Made of seamless copper, by our special process, they are uniform in thickness, high in mechanical strength. Standard shapes up to 18 in.; special types to your specifications.

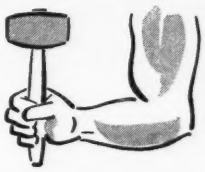
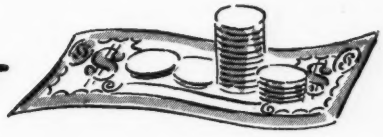
HERCULES FLOAT WORKS
200 Franklin St. Springfield, Mass.

For Low Cost, High Efficiency Water Treatment

use MANZEL CHEMICAL FEEDERS!

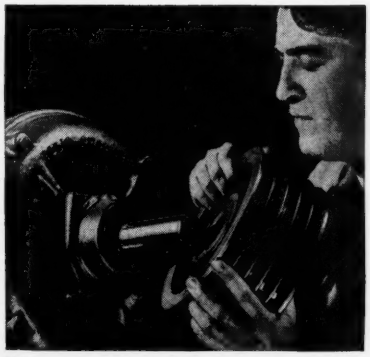
Manzel Feeders inject boiler compound in accurately measured amounts with clock-like regularity. They never forget, and every gallon of water gets the same amount of chemical. Manzels are installed directly on the feed-water pump and start, stop, speed up and slow down with it. Once feed is set, they require no attention except to maintain chemical supply in chemical tank.

Write for Bulletin
MANZEL BROTHERS COMPANY
327 Babcock St., Buffalo 10, N. Y.

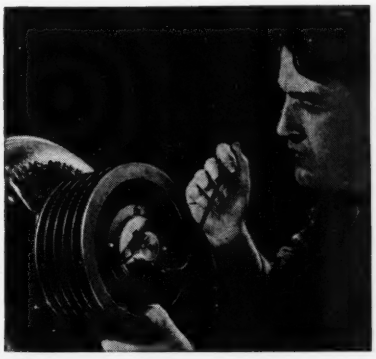
Trade this  for this ; save and 

No more *forcing* of sheaves. Simple wrench operates Allis-Chalmers' "Magic-Grip" — *fastest mounting and demounting sheave on the market.* Saves time, money.

SEE HOW QUICKLY, EASILY THIS NEW SHEAVE MOUNTS AND DEMOUNTS



1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.



2 Align exactly, using straightedge, (It's easy with this free-sliding sheave.) Then tighten three cap-screws; sheave is locked to shaft, *grips like magic!* No set screws to damage the shaft. Write A-C for Bulletin B6310.

RECONVERTING?

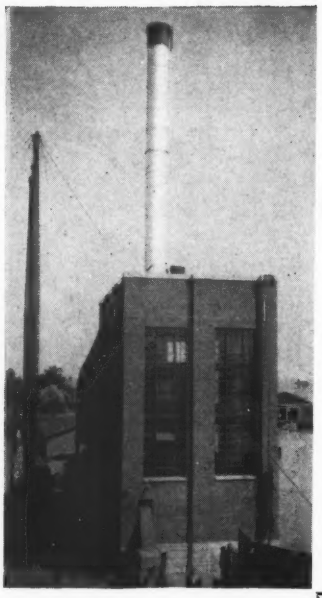
GET THIS NEW FREE KIT!

To help you find out how your present equipment will fit into future production, A-C offers a new free "Reconversion Inventory Kit" — Fact Sheets and Check Lists to speed your appraisal of V-belt drives, electric motors, and centrifugal pumps. Applies to all makes. Call your A-C distributor or district office, or write Dept. 00, ALLIS-CHALMERS MFG., Milwaukee 1, Wisconsin.

A 1855

Allis-Chalmers Texrope

"MAGIC-GRIP" SHEAVES



HOW CONNERY CONSTRUCTION*
Holds Down Maintenance at
DUNN SULPHITE PAPER CO.

Taking a tip from hundreds of other industrial plants and central stations, the Dunn Sulphite Paper Co. at Port Huron, Mich., picked Connery Construction for the breeching and flues of its new and highly efficient power station. For complete description of this plant see January, 1945, Power Plant Engineering.

Here, Connery Construction will eliminate the headaches that result from buckling, warping, loose joints. It will assure maximum contraction and expansion—step up efficiency of draft —prevent internal corrosion—help hold down plant maintenance expense.

Write for 36-page Connery Handbook. It shows how Connery's Expansion Stiffener makes breechings, flues and uptakes serve better and last longer; contains specification data; picture applications in different industries.

CONNERY CONSTRUCTION CO.
Second and Luzerne Sts., Philadelphia, Pa.

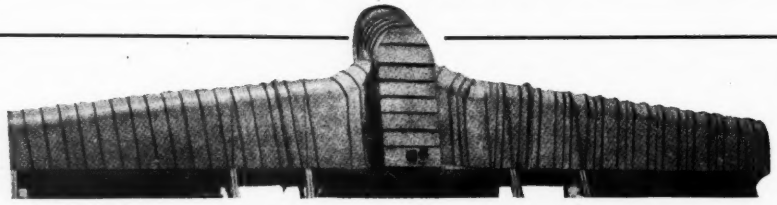
Get a CONNERY BID on:

STACKS

BREECHINGS
UPTAKES

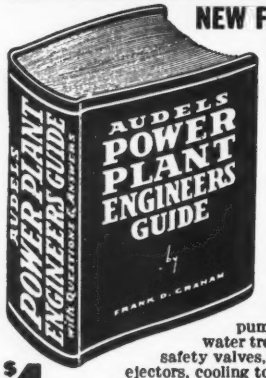
HOPPERS

AIR DUCTS



*Connery Construction is electrically welded, with "V" stiffeners pressed into the metal; permits uniform expansion and contraction; won't warp or buckle.

AUDELS
POWER PLANT ENGINEERS GUIDE
WITH QUESTIONS AND ANSWERS



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A Complete Steam Engineers' Library in One Book!
1500 PAGES—65 CHAPTERS
1700 ILLUSTRATIONS. FULL INDEX

1001 FACTS AT YOUR FINGER ENDS!

PRACTICAL INFORMATION IN HANDY FORM FEATURING: Basic principles of Steam Engineering, including Boiler Construction, Operation and Repairs. Gives practical information on Boiler Calculations, fuels, feed pumps, water heaters, economizers, water treatment, injectors, traps, draught, safety valves, oil burners, stokers, condensers, ejectors, cooling towers, evaporators, steam and hot water heating, pipe fitting & tubing. Contains complete data on all types of Steam Engines and Turbines, Indicators, Valve gear, Valve setting. Air Compressors, Hoists, Gas and Diesel Engine Operation, Lubrication.

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FOR HEATING, AIR CONDITIONING, REFRIGERATION, AND INDUSTRIAL APPLICATIONS

The acceptance of Mercoid Controls is universal. The reason is based on their record for dependable operation and long service. They are easy to install, adjust, and require practically no attention.

The hermetically sealed mercury switches used in all Mercoid Controls are dust, dirt and corrosion-proof, thus assuring positive performance under all operating conditions.

Pressure Control—*For various industrial applications. The operating range is plainly indicated on a visible dial. Adjustments are easily made.*

Temperature Control—*For numerous applications. The operating range is plainly indicated on a visible dial. No guesswork—easy to adjust.*

See catalog No. 600 for complete information on all types of Mercoid Controls.

THE MERCOID CORPORATION
4211 West Belmont Avenue, Chicago 41, Illinois

ENGINEERING PROGRESS REPORT # 1

LJUNGSTROM AIR PREHEATER

The Cold End of the Boiler

In the desire to recapture as much as is possible of the heat that has heretofore been wasted, attention is focused on reduction of temperature of gases from the boiler entering the stack. It is well known that all fuels contain sulphur and the amount of this sulphur has a very direct effect upon all parts of the units which it contacts. These objectionable features in the fuel cause the following:

1. Deposits are formed because of the presence of sulphur in the fuel, and the amount of deposit formation and corrosion rises with the sulphur content.

2. The action of sulphur is to corrode the iron and form iron sulphate, which is hygroscopic and becomes moist and adhesive. This, in turn, collects fly ash from the flue gas, forming an acidic and progressively corrosive paste.

HOW THE LJUNGSTROM IS MEETING THESE CONDITIONS:

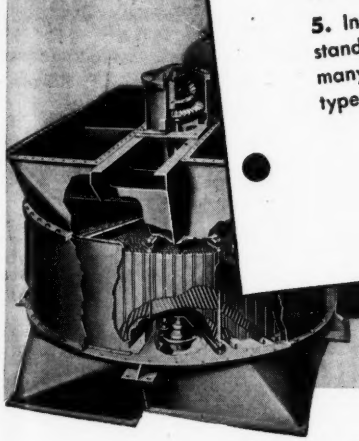
1. At the present time, the simplest method of minimizing damage from this corrosive deposit is to remove it at frequent intervals by mechanical force. This is best done by a jet of high-velocity steam or air applied directly to the deposits. Deposits form at the cold end of the heating element, and the jet of air or steam is more effective when applied at this end.

2. Best cleaning results from application of the mass soot blower in the entering air chamber, with the blow in the direction of the flow of air through the preheater.

3. Generous size glass observation ports in combination with adequate internal illumination aids in determining when the surface needs cleaning and when the cleaning is complete.

4. With sufficient pressures of air or steam, it is possible to clean the elements so that draft loss is maintained at normal levels, even with high-sulphur-content fuels. This can be done while the preheater is in full operation.

5. In view of the fact that all plants have their peculiarities, either from the standpoint of fuel or method of operation, judgment must be used in applying many of these observations, made through the entire range of fuels and many types of installations.



THE

AIR PREHEATER

CORPORATION

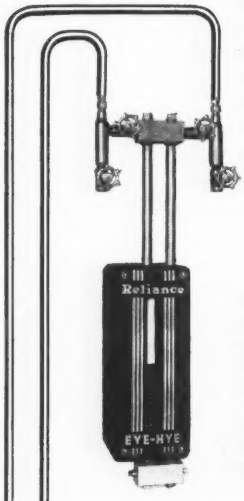
Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

Reliance EYE-HYE has unusual *flexibility of placement*

besides its dependable accuracy in remote water level reading

EYE-HYE gives you accurate eye-level water level indication that makes it almost impossible to avoid reading it, frequently. One of its greatest appeals is its *flexibility of placement* — that is, EYE-HYE *can be placed at any convenient point,* with very few restrictions.

Since flexible tubing is the connecting medium, you can bend the tubes around corners, girders, piping, other equipment — running them any reasonable distance from the drum to the location you select for the EYE-HYE. And it's no trick to change it. Write for Bulletin 382-C, describing EYE-HYE and how it operates.



* * *

For the engineer who strives for efficiency and safety in locating wiring and piping, EYE-HYE*'s connecting tubes can be run under the floor to reach instrument location.* EYE-HYE *is made by The Reliance Gauge Column Company, Cleveland, Ohio.*

Write for Bulletin 382-C to

The Reliance Gauge Column Company

5902 Carnegie Avenue • Cleveland 3, Ohio

Reliance

BOILER SAFETY DEVICES SINCE 1884

FOR SALE

Approximately twenty used model H 250-pound per hour capacity Fairbanks Morse Stokers. These Stokers have been used around two years and are offered subject to prior sale at approximately one third their original cost. If interested write or wire

TENNESSEE EASTMAN CORP.

Kingsport, Tennessee

C. H. Wheeler of Philadelphia

STEAM CONDENSERS

•

STEAM EJECTOR TYPE VACUUM PUMPS

•

MECHANICAL DRAFT WATER COOLING TOWERS

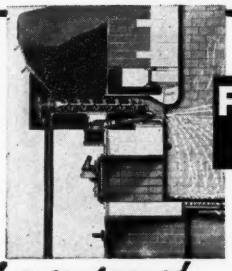
•

DECK MACHINERY

C. H. WHEELER MFG. CO.

19th ST. and LEHIGH AVENUE, PHILADELPHIA 32, PA.

Want More Steam in a hurry?



Put in

FYR-FEEDER MULTIPLE SPREADER STOKERS

QUICK FACTS—

- **FYR-FEEDER is automatic, modern, high efficiency firing at its best!**
- **Increases boiler capacity with cheapest grades of coal — screenings or sweepings, wet or dry.**
- **Easy to operate. Responds instantly to sudden load changes. Burns fines in suspension; larger pieces on grate. No banking losses.**
- **Dependable. Multiple Burners. Quality construction.**
- **Easily installed in minimum time. Standard ratings up to 1200 lbs. of coal per hour. IF YOU ARE IN A HURRY WIRE, PHONE, OR WRITE.**

A war-proved product

FEATURING:

AIR JET COAL PROPULSION

FYR-FEEDER *Multiple Spreader* **STOKER** ITS EFFICIENT ITS AUTOMATIC PAYS FOR ITSELF

FYR-FEEDER, Engineers—22—18 E. Erie St., Chicago 11, Ill.

☐ YES! Please send literature. Name_____

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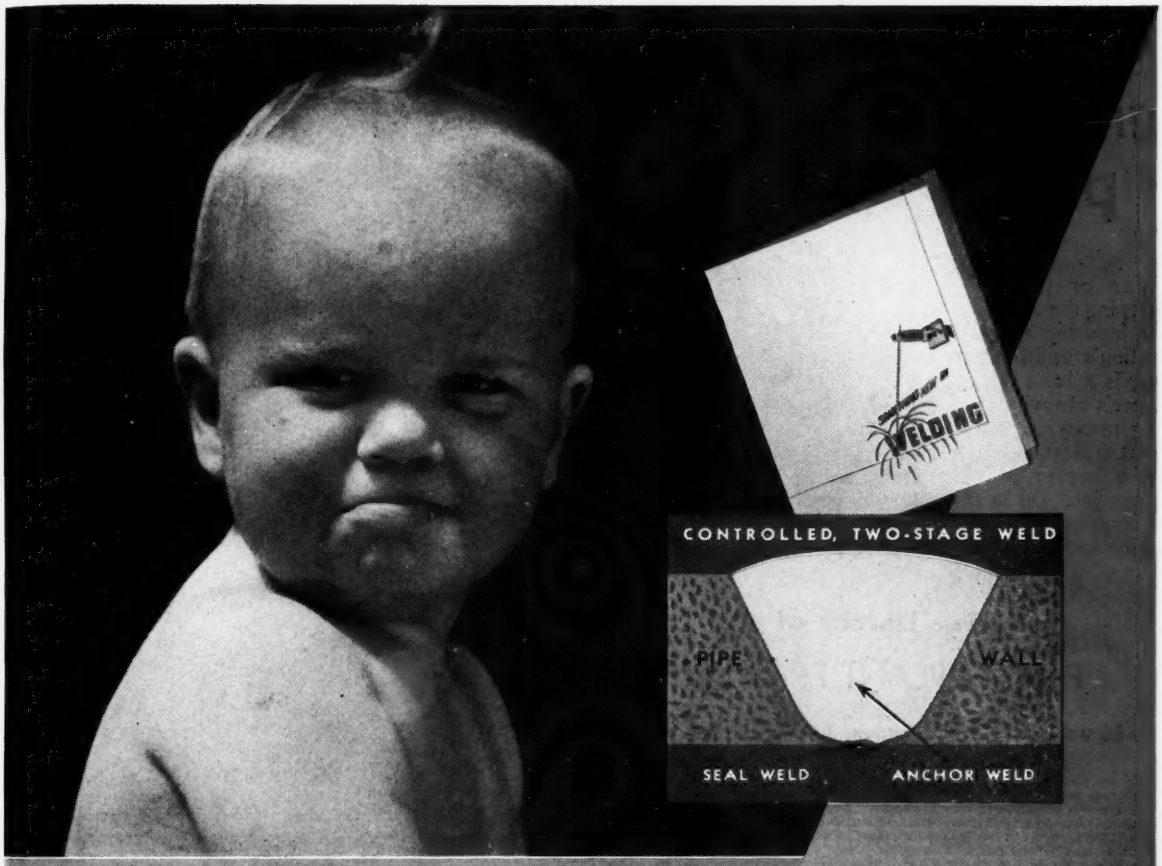

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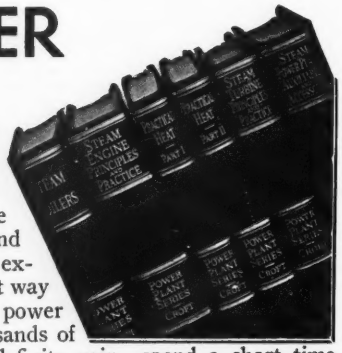

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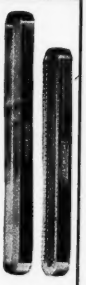

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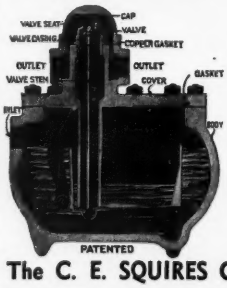

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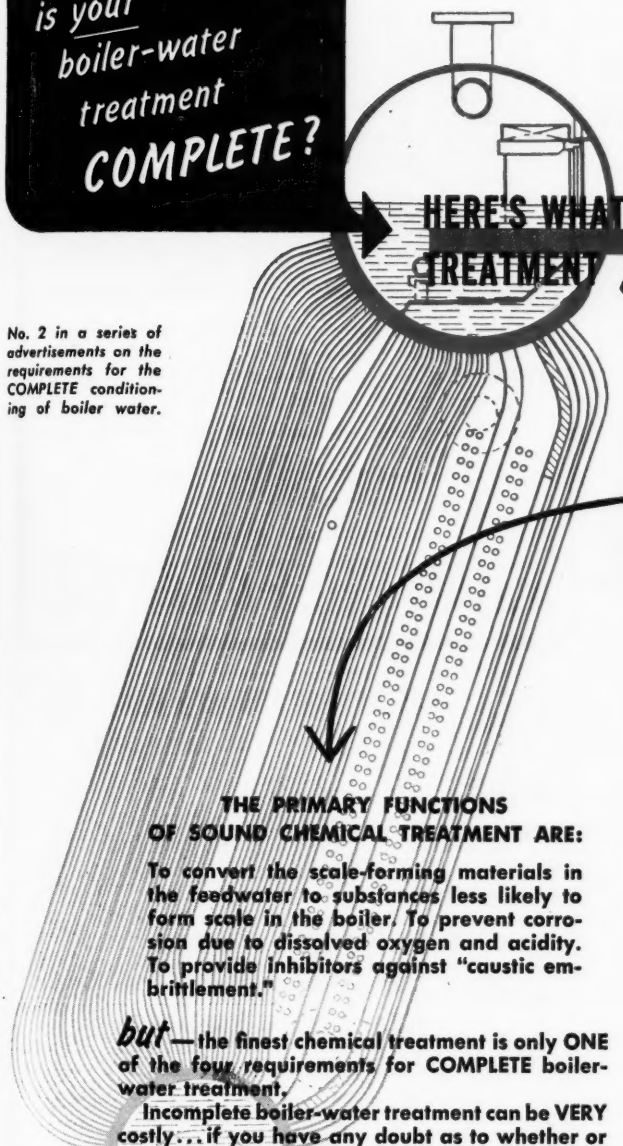

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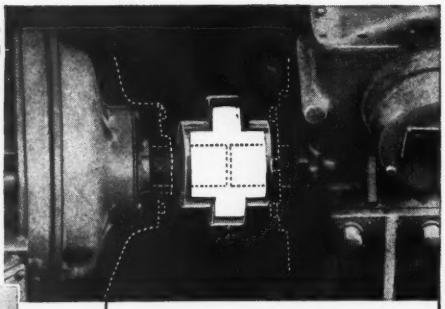

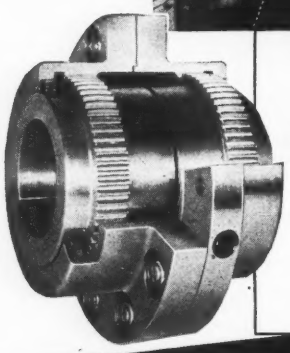

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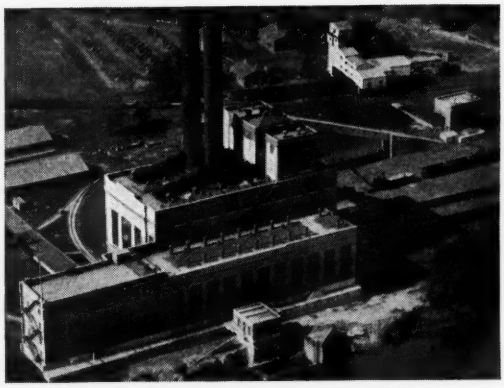

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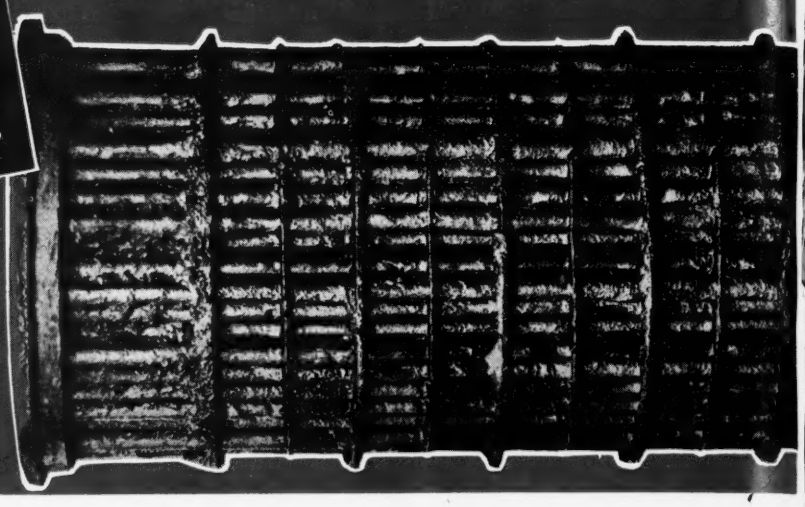

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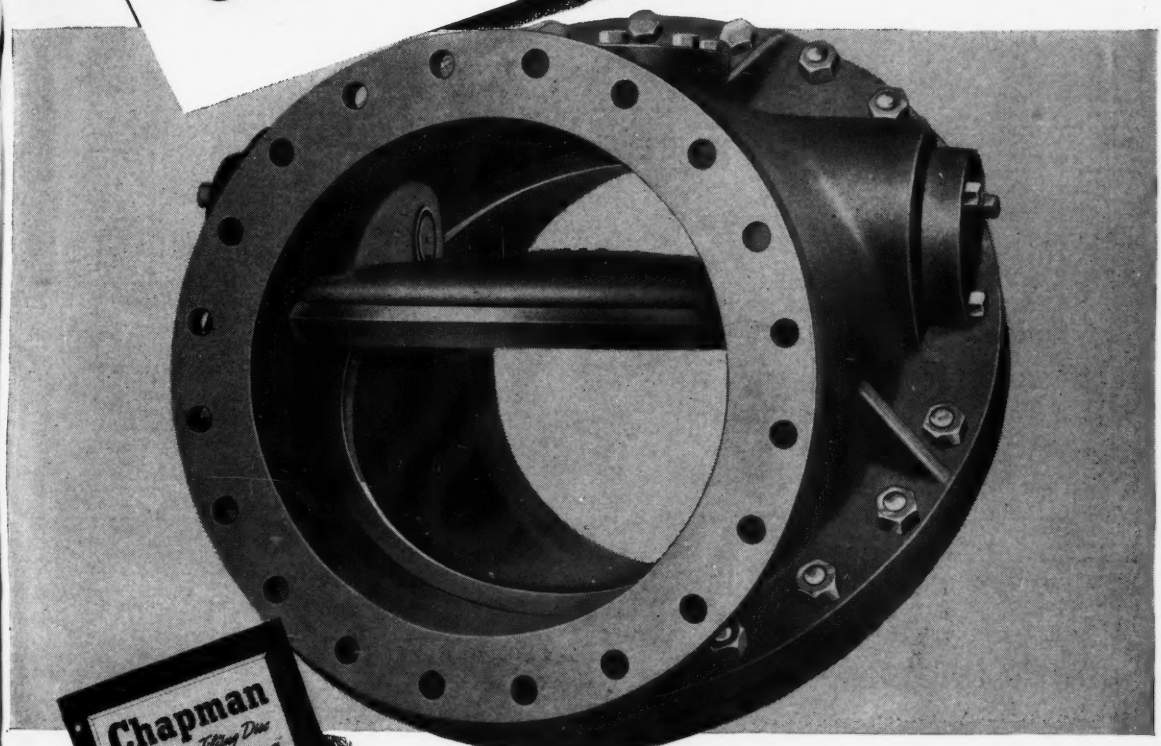
CHAPMAN CHECK VALVES

TILTING DISK



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Close Quickly and Quietly

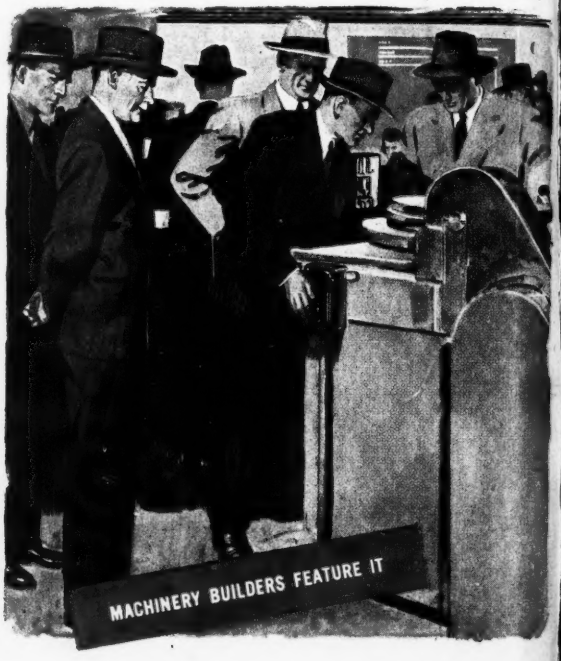
The cushioning effect of the stream against the short flap of the balanced disc permits quick, quiet closing. This prevents water hammer and resultant destructive stresses in pipe lines. Head losses are cut to about a quarter of those caused by ordinary types of check valves. Substantial power savings are possible when these valves are installed on pump discharge lines.

The Chapman Valve Mfg. Company, Indian Orchard, Mass.

CHAPMAN NON-SLAM CUSHIONED CLOSING **CHECK VALVES**

The choice of experts everywhere

The makers of electric motors have a keen interest in the dependability of the control equipment used with their motors. The vast majority recommend Cutler-Hammer.



Machinery builders know that dependable machine performance means more satisfied customers, a better reputation. Leading machinery builders feature Cutler-Hammer.

Cutler-Hammer Motor Control in all generally used types and sizes is carried in stock and proudly recommended by recognized electrical wholesalers in every community.

Almost *all* of America's manufacturing operations today depend on the smooth performance of electric motors. That is why experienced factory managers make the selection of dependable motor control one of their definite responsibilities. They know the improper operation or failure of *any* motor, large or small, can cause production losses far too costly to be chanced by the careless purchase of motor control. That is why it is common practice in thousands of factories to specify motor control not only by type but by name . . . Cutler-Hammer . . . for assured dependability.

The small Cutler-Hammer manually operated starter (Bulletin 9115) shown here clearly demonstrates the engineering leadership which has made Cutler-Hammer the choice of experts everywhere. This unit, though barely larger than a man's hand, offers such famous Cutler-Hammer features as dust-safe vertical contacts and eutectic alloy overload protection. It is simple, compact, and rugged. It is easily installed, easily wired, easily inspected and completely dependable in performance. It is obvious proof that even the smallest industrial motors can have the best in control at no extra cost. CUTLER-HAMMER, Inc., 1392 St. Paul Avenue, Milwaukee 1, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto.

CUTLER-HAMMER
MOTOR CONTROL
C-H